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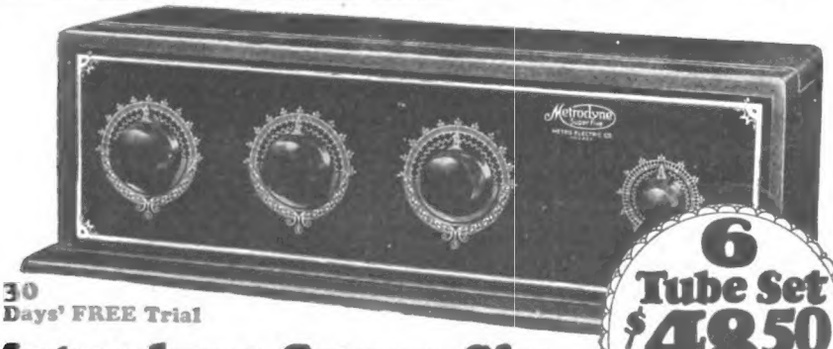

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Vol. XIV.
Whole No. 164

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December, 1926
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IN JANUARY ISSUE

Fake Radio Doctors

Thousands of dollars are paid annually for home treatment machines advertised as employing radio for the curing of diseases. Read why they are fakes.

Card Tricks

Nothing seems to interest people quite as much as card tricks and magic. Some simple card tricks will be described in January issue.

Foiling the Yeggmen

Several new scientific tricks to foil the attempt of safebreakers; you will find the illustrated article in the next issue very interesting.

Blueprint Reading

Another article showing in simple fashion how to read shop blueprints.

What is the Shape of the Moon?

One of the foremost astronomers in America answers this popular question.

How to Build a Good "B" Eliminator

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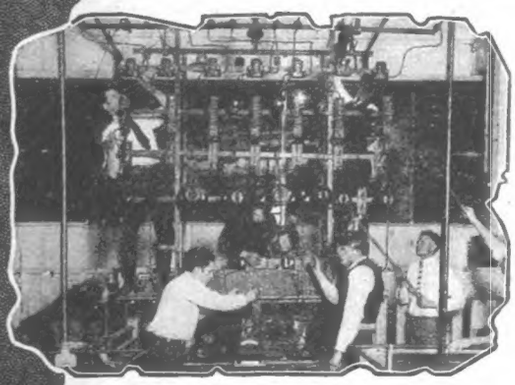

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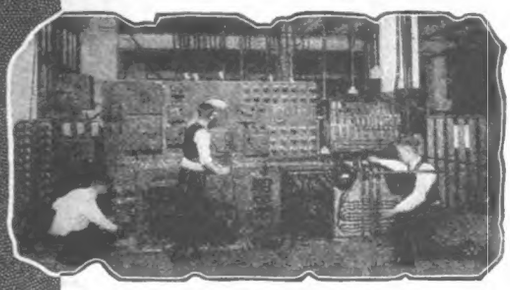

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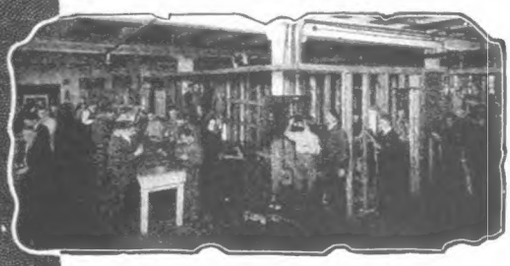

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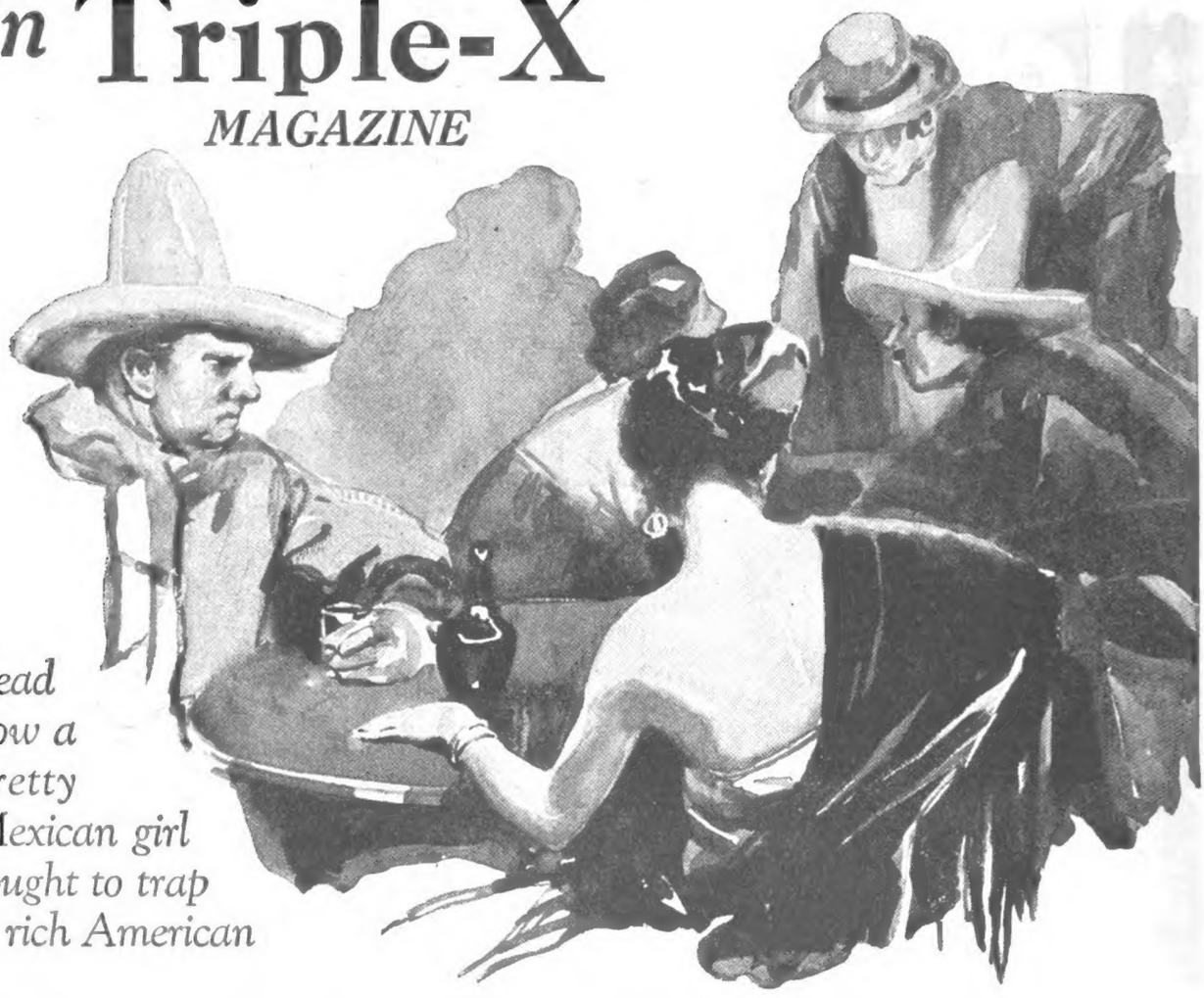

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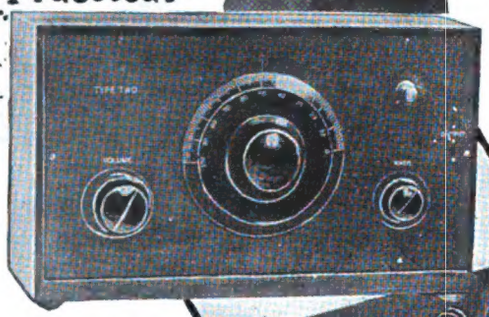

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Volume XIV
Whole No. 164

Science and Invention

Dec., 1926
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HUGO GERNSBACK, *Editor-in-Chief*
H. WINFIELD SECOR, *Managing Editor*
DR. T. O'CONOR SLOANE, Ph.D., *Associate Editor*
Editorial and General Offices, - - - 53 Park Place, New York

"Those Who Refuse to Go Beyond Fact Rarely Get As Far As Fact" - - - HUXLEY

SCIENCE MEETS THE IMPOSSIBLE

By HUGO GERNSBACK

HUMANITY has become so immune to the marvels of science that we no longer are astonished at anything. We have become so used to the "impossible" that we have actually come to accept it without question.

But every once in a while science discovers something that really makes us sit up and take notice, on account of its tremendous importance, and even the word "impossible" fades into nothingness.

Suppose someone stepped up to you and handed you a small ball. If you clutched at it with sufficient force, either one of two things might happen. The weight of this seemingly innocent article would probably either tear out your fingers, or, if you grasped the ball tightly enough, your arm would be torn from its socket. The little sphere would strike the floor, and even if the floor were made of cement or concrete, it would go right through it as if it had been fired from a cannon. It would probably go in succession through all the floors of a skyscraper and bury itself in the ground for many feet. You see, the little sphere, the size of a baseball, actually weighs a little over 14 TONS, or approximately, one ton per cubic inch.

Of course there would not be anybody strong enough to hand you the ball in the first place, because nothing but a power derrick could lift it. And, furthermore, it is to be doubted whether it will be within any conceivable time that some one will be able to make a sphere as just described. Nevertheless, the material exists. This substance, for which we have no name, actually is in existence today and is contained in the densest star we know, which is the small satellite of Sirius; it is a star not much larger than our own earth, but weighing almost as much as our sun. For a long time scientists could not believe that such an aggregation of matter could be contained in such a small space, but we know today that such is the case, and we have to accept the facts, staggering and quite impossible to the human mind as they are.

We know that matter under tremendous and unthinkable pressure will shrink just like a sponge, and this apparently can be carried on almost indefinitely, as far as we know. This happens to be the case with all the heavy stars which have been investigated. It is even possible that such fluid substance exists in the inside of the earth, where the pressure is so great that everything must be in a molten state. Science, for instance, today believes that the core of the earth is of iron—as we may put it—a solid iron, and yet liquid. Conflicting as this statement sounds, the tremendous pressure liquefies the metals, of whatever nature they may be, and at the same time such materials may be far more solid than wrought iron.

Staggering as is the example of the material weighing one ton per cubic inch just mentioned, it fades to the vanishing point when we come to the substance called Neutronium, which scientists know today also exists. Neutronium, if you please, weighs 60,000,000 tons per cubic inch. The whole of the Woolworth Building weighs only 100,000 tons, and it is a building some 200 feet square and almost 1,000 feet high. *It would take 600 Woolworth Buildings, if placed in a scale, to balance one cubic inch of Neutronium.*

These are staggering facts, but are facts nevertheless. The Neutron is the name given to the combination Proton-Electron. The electron itself is only one ten-trillionth of an inch in diameter, and when such combine by colliding with a Proton, a Neutron is formed.

To understand this, it should be noted that in hydrogen gas the nucleus of the atom is composed of only one particle, which we call the Proton. Around the Proton a single Electron circulates in the path of a perfect circle. The Proton and Electron attract each other with a tremendous force, and the only way the Electron can keep from plunging into the central nucleus is by circling around it, just as our own earth circles around the sun. But the Proton is about 1,800 times heavier than the Electron. On the other hand, a hydrogen Proton is no more than one ten-quadrillionth of an inch in diameter, and it does not often happen that the Electron and Proton collide with each other; it happens only when some outside force disturbs the combination. When this occurs, and the two collide, they merge into one and disappear from sight completely. The combination produces the Neutron, which has as yet never been isolated, but science knows that it exists. It is not affected chemically. It can not be seen, and we have as yet no means of getting at it at all. This is on account of its extremely small size, so small that it immediately falls, passing through every material on its way. It passes through glass walls, metal buildings, the earth itself, and continues falling right through the earth, passing through the center and emerging on the other side, only to fall back. It then keeps up a pendulum-like motion, its speed decreasing after it emerges on the other side of the earth, until finally, due to friction, it locates at the center of the earth, where it comes to a stop.

Scientists have calculated that the minimum density of solid Neutronium is 4 trillion times that of water. This makes the stupendous weight of about 60 million tons per cubic inch. It should be noted, at this point, that the Electron and the Proton at first were nothing but electrical charges, but on uniting they became a solid particle, the Neutron, or Neutronium. Thus science today believes that all matter in its final stage is electrical, while the Neutron itself, made up of electrical charges, is a substance, in other words, of the materials of an atom.

Just what these discoveries may mean to humanity, no one can foresee today, or even calculate. One wild guess is as good as another. Even if we should be able to isolate a small particle of Neutronium, we would have nothing to keep it in captivity, as it would go through everything just as water falls through a sieve. We would have no means of retaining it unless it were by electrical means, and this, of course, is quite possible. The quantity of isolated Neutronium, however, would of necessity be microscopically small, because even the smallest quantity visible to the naked eye would be of such great weight that it would be impossible for anything to hold it captive.

What benefits the human race may derive from this knowledge or the isolation of Neutronium, it is impossible to predict. It is fair to say, however, that in years to come, not only our entire conception of matter will be revolutionized, but our entire mode of living, and, indeed, our entire lives, will no doubt be affected by these discoveries, mysterious as they may seem today.

Matter under great compression seems to be something totally different from matter not compressed. Only during the past 100 years have we found out this important fact, and already industry is beginning to make use of this discovery. For instance, liquid air is a product due to compression as also is refrigeration. The chemical industry is possibly the biggest where compression of gases, as in the fixation of nitrogen of the air and of solids is constantly coming into greater use. But of course the pressures that we have been working with so far, are really infinitesimal compared to those that we shall use in years to come. We may never be able to produce pressures that will give us a solid weighing 14 tons per cubic inch, not to mention 60 million tons per cubic inch.

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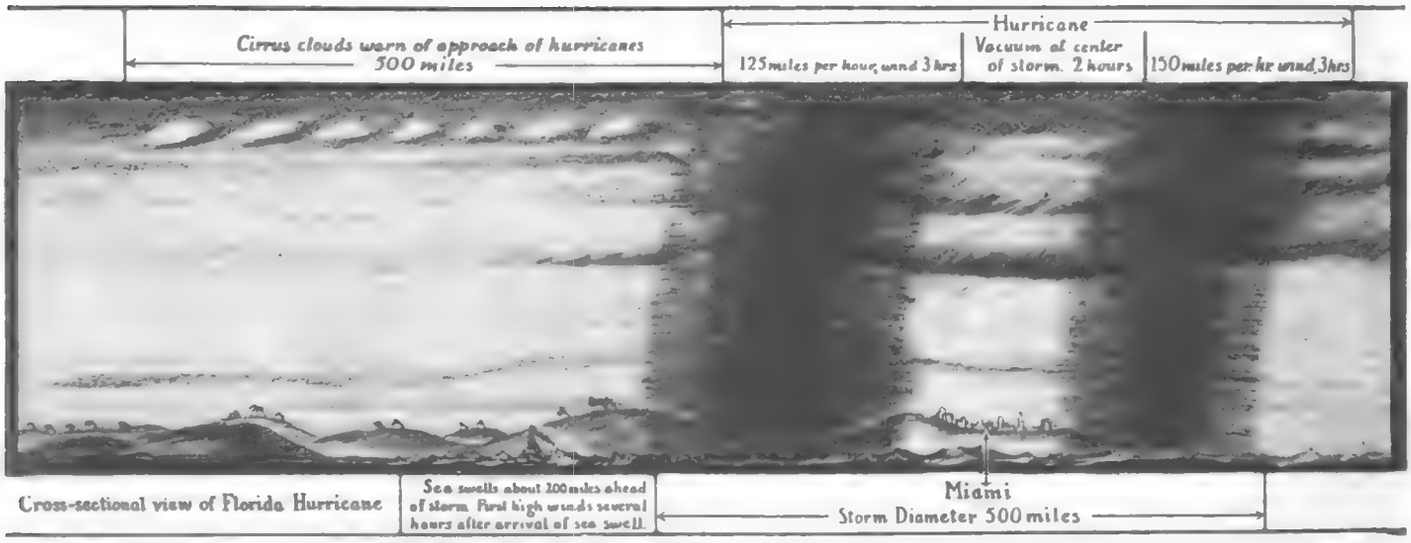
WHY FLORIDA HURRICANE

Popular Explanation of Florida Hurricane by Well-K New York


Cirrus clouds warn of approach of hurricanes
500 miles
Hurricane
125 miles per hour, wind 3 hrs
Vacuum at center of storm. 2 hours
150 miles per hr wind 3 hrs
Cross-sectional view of Florida Hurricane
Sea swells about 200 miles ahead of storm. First high winds several hours after arrival of sea swell.
Miami
Storm Diameter 500 miles

A remarkable cross-section view of the Florida hurricane which gives a clear idea of how the two "blows," with an intervening quiet spell of about two hours took place. The top view of this hurricane shown on the opposite page will help the reader to gain a clear idea of the physical make-up of this and all other hurricanes. E. B. "Farmer" Dunn, well-known weather expert, prepared the accompanying article and he blames much of the property loss and deaths on the Weather Bureau, who did not display storm warnings far enough in advance. Experts can tell many hours ahead when a hurricane is approaching, as drawing above shows. Storm above is moving from right to left across the page.

THE most disastrous hurricane that ever visited the South Atlantic coast struck the southern end of Florida at Miami about midnight of Friday, September 17th, and by 3:15 A. M. of Saturday, the 18th, the storm raged with great violence. Its severity lasted until 6 A. M., then an abatement came in the passing of the storm centre. For a period of two hours, during which the sky cleared, the wind ceased and a comparative calm prevailed. The lull in the storm was in reality the most treacherous period. It led the people into a sense of false security in thinking that the storm had passed. Many left their homes and were exposed to the fury of the afterblow, which is always of greater violence than that before the passing of the storm centre. The wind at each period of the storm had an approximate maximum velocity ranging from 100 to 150 miles an hour. The lowest barometer record was 27.62.

HURRICANE WITHOUT PROPER WARNING

As early as Thursday, the 16th, the Weather Bureau had knowledge of the approaching hurricane. The 8 A. M. map of Friday the 17th, showed the storm to be moving nearer Florida, with increasing intensity; the advance heavy rainfall then reached as far north as Jacksonville. No heed was paid to these facts and no warning given. The weather summary on the same map read as follows:—"Hurricane in the vicinity of Southern Florida and evidently of minor intensity." No one with a knowledge of hurricanes would have made such a statement. Early Saturday morning, the 18th, the storm was sweeping with great force across the southern end of Florida, having before 6 A. M. caused the loss of hundreds of lives and millions of dollars of property. Two hours after the storm had passed Miami, the weather map appeared with the statement as follows:—"The southern storm is apparently central, east of and near Southern Florida and probably still advancing northwestward." Timely and accurate warning would undoubtedly have saved many lives.

The hurricane on reaching the west coast did considerable damage, although it had lost some of its force and deposited the greatest volume of rainfall on the east coast. Between Sunday and Tuesday it moved very slowly and was practically stationary between Pensacola and New Orleans; the rotary force diminished to light winds and the storm dissipated.

CHARACTERISTICS OF STORMS

There are elements of regularity in the history of hurricanes which are quite distinctive, their place of birth, the season of the year and their serpentine course. They are the only storms taking a westward course, before they recurve to the northeast. They are in all features similar to the "Typhoon," except that the latter has its birth south of the equator and travels directly opposite.

Knowledge of hurricanes is based upon a firm foundation of observed facts. It is on such a foundation that the "law of storms" is formulated. A forecaster possessed of these facts should make most accurate predictions of these storms.

WHAT A HURRICANE IS

Hurricanes of the West Indies and Typhoons of the East Indies are what are termed cyclones in the temperate zones, but owing to their greater developement, magnitude and power, which they attain in the torrid zone they have been given the more terrifying titles of "Hurricanes" and "Typhoons." The hurricane season is from July to October inclusive, although these storms have infrequently occurred in other months.

Many people wonder where the Florida hurricane started and what became of it after it had caused so much damage in the state of Florida. The map above prepared by Mr. Dunn shows where hurricane started, its path northward and point where it died out between New Orleans and Pensacola.

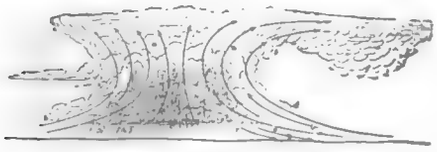
OCCURRED

By E. B. "FARMER" DUNN

nown Expert, Former Chief U. S. Weather Bureau at City.

The two photographs herewith give a very good idea of the terrific power of the wind and waves as they swept over Miami and other Florida resorts. Newspapers mentioned winds of 125 miles per hour velocity; Mr. Dunn stated that from the barometer readings, he knew that the wind reached 175 miles per hour and upward.

The hurricane has its birth in the southern region or zone of easterly trade winds and generally east of the Windward Islands or on the border of the Torrid zone of the equatorial belt of calms, which ranges close to latitude 10 degrees north. At the hurricane season, extensive areas of calm, sultry and rainy weather stretch



The drawing above shows general storm formation, such as occurs in the case of a hurricane, the arrows indicating the ascending column of warm moist air, this warm air rushing in from areas extending for many miles.

from the west coast of Africa to the north coast of South America. As these great storms move northward their progress is slow at first. They gather in moisture until the excessively heated and widely expanded atmosphere is thoroughly saturated, thus greatly reducing the atmospheric pressure for miles around the embryo centre, which creates a low pressure area deeper than is usual in the ordinary cyclone. The barometer continues to fall and the inrushing air starts a whirl as the over-heated air ascends higher and higher, and the storm moves over the central region of abnormal heat, being carried forward by the movement of the upper atmosphere. The lower strata of hot, moist air continue their rush toward the storm centre, feeding the central column and giving greater progressive and rotary motion.

Clouds are formed and spread far in advance of the body of the storm; as soon as the colder strata of air in the north is reached, the moisture is condensed; rain falls in torrents or cloudbursts, liberating the great amount of latent heat absorbed in the process of evaporation, thus giving greater impetus to the storm's progress. The inflowing air at the surface blows horizontally and with increasing force as it approaches the centre, where it joins the upward spiral or rotary motion. The progressive motion may not be more than twenty-five miles an hour, but the rotary or destructive force may reach from fifty to two or three hundred miles an hour.

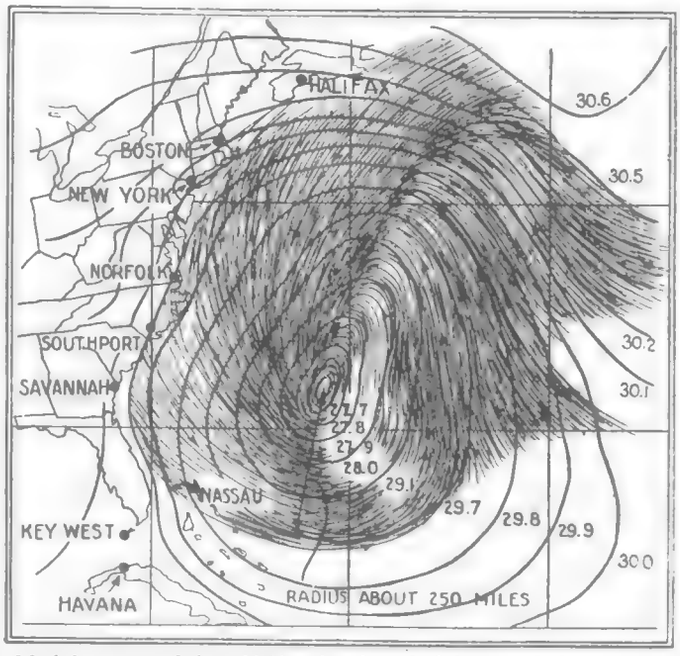
DETECTING APPROACH OF HURRICANE

There is an outward flow of air at the top of the storm center, which spreads far in advance, producing cirrus (feathery) clouds which are the forerunners of the approaching storm. These clouds precede the storm some four or five hundred miles. Another pronounced indication of an approaching storm is the sea swell, which also precedes the storm by several hundred miles. Before the approach of these storms the barometer shows an unusually high reading for the latitude and season, and almost always a dead calm exists for some time and the weather is such as would indicate to the layman no cause for alarm. Such is Nature's camouflage to deceive the unwary. It is not long after the motion of the central column sets in, that the storm moves from the place of its formation in a westerly course, contrary to the general movement of storms in more northerly latitudes. The westerly movement terminates when the storm center reaches the neighborhood of 25 or 30 degrees north latitude and comes within the influence of the prevailing south and west winds. Then it recurves to the northeast. The point of recurve may bring the centre of the storm to the vicinity of the west Gulf coast or the east of Florida.

On the close approach of these storms the weather which has been balmy and calm, becomes hazy; a surface breeze springs up, coming from the opposite direction to the flow of the clouds. The breeze blowing toward the centre of the impending storm, and

(*Continued on page 765*)

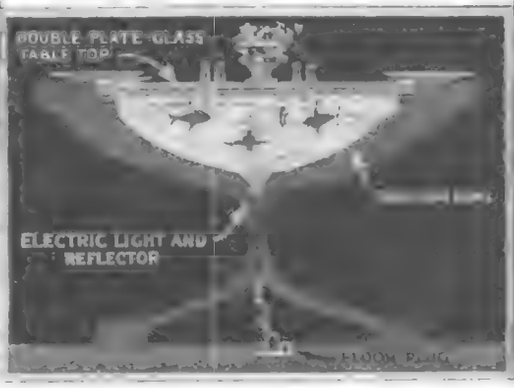
The drawing to the right shows a top view of a tropical hurricane, such as that which destroyed millions of dollars worth of property and hundreds of lives in Florida a few weeks ago. This top sectional view of a tropical hurricane is that of a storm which occurred quite a few years ago. Note the general circular motion of the air currents, these currents coming in from the upper right hand corner and swirling around in vortex fashion, forming a vacuum at the center. The radius of such a storm is about 250 miles and the diameter is about 500 miles. Referring to the cross sectional view on the opposite page, one now sees that with every hurricane there are two "blows" felt, and not three as some of the newspapers reported. The first blow at about 125 miles per hour velocity lasted about three hours; then came a period of two hours while the vacuum center of the storm passed and fooled many people into thinking that the end of the storm had come; finally came the second and hardest blow, as the rear section of the storm passed over, with the wind blowing at a velocity of 150 to 175 miles per hour. This second blow lasted about three hours, the terrific wind ending abruptly. At the start of the hurricane the wind comes on more gradually, and to the trained weather observer or sea-faring man, Cirrus clouds about 500 miles ahead of the storm warn of its approach, followed by the sea swell about 200 miles ahead of the storm. The average forward velocity of the storm center is 25 miles per hour.



Magic Tables and Floor In New Restaurant

By H. WINFIELD SECOR

New York City's newest night club, Le Perroquet de Paris, will boast of some of the greatest novelties imaginable. The glass covered tables, when lit, will expose live gold fish swimming about.



Glass dance floor, under which electric lights will glow; with lights out floor becomes mirror.

NEW YORK CITY'S newest night club, Le Perroquet de Paris (the Parrot of Paris), will provide many new surprises. Among other features is the most remarkable dance floor ever seen in America. It will be made of double thick plate glass, under which powerful electric lights will blaze upward. The other lights in the restaurant will be of course carefully toned down, so as to emphasize this dance floor feature. At frequent intervals the dance floor lights will be switched off, and the table lights switched on. When this happens the glass floor becomes a mirror, and the guests seated at the tables experience the startling novelty of seeing real live gold fish swimming about under their plates. When the table lights are switched off, the glass top becomes a mirror. The lights for the orchestra in the gold cage flash out from under the stuffed parrot. Roger Wolfe Kahn, a leading director of jazz orchestras, is sponsor of this newest idea in night clubs. Mr. Kahn's associate in this enterprise is Rene Racover, famous French flier and formerly director of the Café de Paris in New York City.

When lights under glass dancing floor are extinguished, the floor becomes a mirror, and the lights under the tables having been switched on, swimming gold fish become visible to the guests seated about the tables. Orchestra plays inside giant parrot cage symbolizing restaurant's name.

Paper Actors Movies' Latest

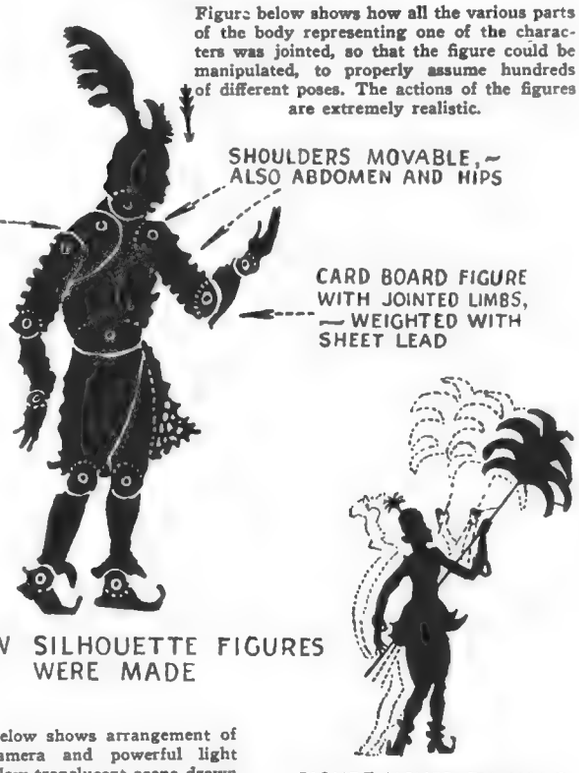
Latest "Shadow Film" Novelty Presents "The Story of Prince Achmed."

Showing how scenery and figures were moved by hand for each successive exposure in new shadow film.

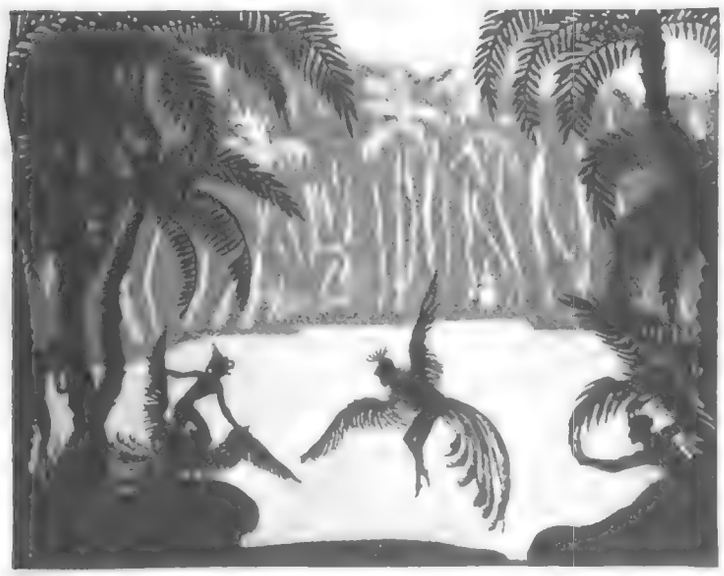
In the drawing above one will perceive how many figures were moved simultaneously by being joined together.

The latest German wonder film, photographed entirely with silhouette paper actors moved by hand over translucent backgrounds drawn in various tones of black or gray, necessitated the manipulation of scenery and character silhouettes every time an exposure was made. Three years of solid work were required to film "The Story of Prince Achmed," 250,000 pictures being taken, 100,000 of which were finally used.

Figure below shows how all the various parts of the body representing one of the characters was jointed, so that the figure could be manipulated, to properly assume hundreds of different poses. The actions of the figures are extremely realistic.

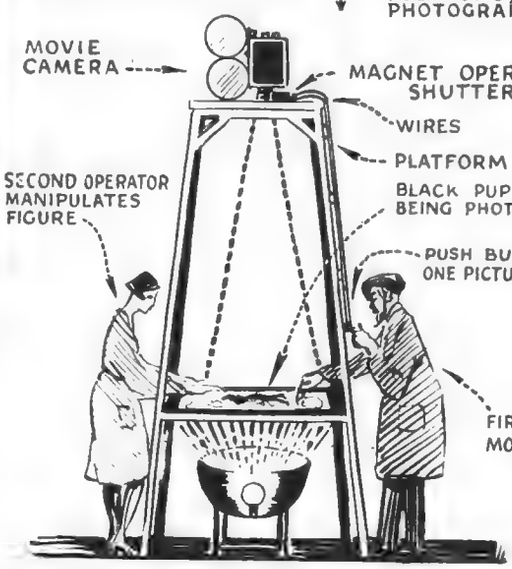

SHOULDERS MOVABLE, — ALSO ABDOMEN AND HIPS
ALL BLACK SILHOUETTE
CARD BOARD FIGURE WITH JOINTED LIMBS, — WEIGHTED WITH SHEET LEAD

HOW SILHOUETTE FIGURES WERE MADE



Beautiful scene from the new German photoplay "The Story of Prince Achmed." The moving figures and trees were hand manipulated. Beautiful rippling water effects were obtained by means of cut paper and sand moved over glass.

Picture below shows arrangement of movie camera and powerful light placed below translucent scene drawn on parchment, and over which opaque figures were moved by hand.



IN THREE YEARS' TIME OVER 250,000 SEPARATE PICTURES WERE TAKEN, 100,000 OF WHICH WERE USED IN MOVIE

SCENES PAINTED OR DRAWN IN VARIOUS TONES OF BLACK OR GRAY
BLACK OPAQUE FIGURE MOVED BY HAND OVER SCENE DRAWN ON PARCHMENT
SCENE TRANSLUCENT
ILLUMINATED FROM BELOW

The reflector and lamp below the scene were in light-tight box.

THE wonderful new novelty in motion pictures, the "shadow film," here illustrated and described, is the conception of a Berlin craftswoman, Lotte Reiniger, as well as a number of other young artists, including Walter Ruttman, who became famous through the wonderful photoplay, "The Cabinet of Dr. Caligari." In this shadow film, all sorts of natural, yet startling effects are produced, such as fairy scenes.

IN the new photoplay described herewith and in which no living characters appear whatever, infinite patience as well as artistic skill of the highest degree was required. The backgrounds were so cleverly handled with regard to the different depths of tone, that the buildings and other objects seemed to actually exist in the solid form. Likewise the figures were so cleverly constructed and manipulated, that one can hardly believe that he is looking at a scene filmed from a mere piece of parchment, on top of which a series of cardboard people are moved around by hand. The presentation of this new shadow photoplay has been much enhanced by the creation of special music to accompany it, which music was prepared by Wolfgang Zeller. Imagine the clever work involved in moving as many as sixty figures simultaneously in some of the mob scenes.

A New and Important Prize Contest

WIREKRAFT $3,000.00

BY HUGO
Member American

Fig. 1. Above we see an assortment of wire of various sizes which can be conveniently purchased on spools as this illustration shows. Wire of this nature can be used for the making of models for the Wirekraft Contest and those particular types of wire represented in the illustration were furnished through the courtesy of E. H. Tate Mop & Cordage Co.; The Malin & Co.; The Cornish Wire Co.; U. T. Hungerford Brass and Copper Co., and the Russell Fraser Wire Co.

OUR Matchcraft Contest, one of the most unique handicraft contests ever staged anywhere, has proved a great surprise to many people for the astonishing variety of models and things that can be fashioned out of matches. We are are now about to begin another contest termed "Wirekraft", which, in our opinion, will far surpass even the popular Matchcraft Contest. The difference between the two contests is obvious. With matches only models can be built that in the very nature of the material can not be used for utilitarian purposes.

Wirekraft is a new art which simply means "What can you do with wire?" At once you will perceive that there are really no limits to this new handicraft, which should become popular over night. Myriads of things can be constructed from wire by any intelligent builder handy with a few elementary tools. Anything from a floor lamp to a replica of the Woolworth Building can be built from wire. Any number of useful things also can be made for use in the home, the office, the factory, or the automobile, and even for your radio. The possibilities are endless and we know that the contest will no doubt be one of the greatest that has ever been staged anywhere. We know it will bring out the latent ingenuity of almost any one who comes in contact with Wirekraft, and it is hoped that an entirely new art may be developed.

Unlike the Matchcraft Contest, Wirekraft is of a much more substantial nature. The models and articles will keep indefinitely, and furthermore the builders will have something for their pains when they have finished building their Wirekraft Models or appliances. In these pages we have just shown a few illustrations of what can be done. Before going further, be sure that you do not duplicate any of the things shown in these pages, because such articles will positively **NOT**

Fig. 3. This photo shows the construction of a tube of wire. The wire is wound on a cylindrical form, removed and soldered.

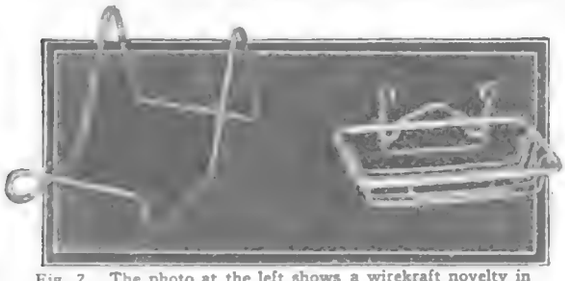
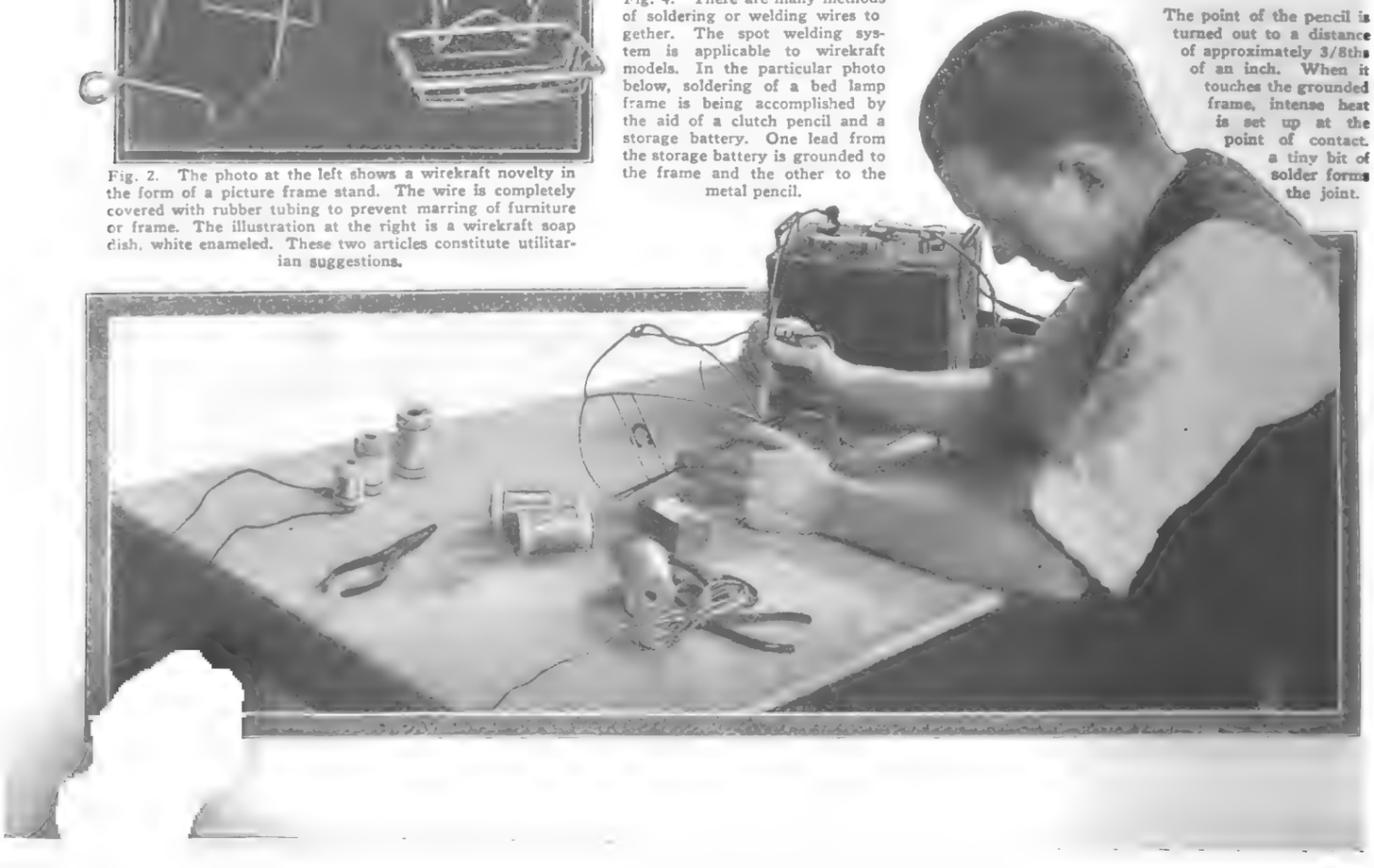


Fig. 2. The photo at the left shows a wirekraft novelty in the form of a picture frame stand. The wire is completely covered with rubber tubing to prevent marring of furniture or frame. The illustration at the right is a wirekraft soap dish, white enameled. These two articles constitute utilitarian suggestions.

Fig. 4. There are many methods of soldering or welding wires together. The spot welding system is applicable to wirekraft models. In the particular photo below, soldering of a bed lamp frame is being accomplished by the aid of a clutch pencil and a storage battery. One lead from the storage battery is grounded to the frame and the other to the metal pencil.

The point of the pencil is turned out to a distance of approximately 3/8ths of an inch. When it touches the grounded frame, intense heat is set up at the point of contact. a tiny bit of solder forms the joint.



—A NEW ART Prize Contest

GERNSBACK
Physical Society

be awarded prizes. The editors want new and novel things, not articles that can be bought in the open market now. Furthermore there are a number of large manufacturing concerns making a specialty of manufacturing wire appliances. Articles of this kind obviously can not be admitted to the prize contest as only novel things are wanted. The rules are clearly stated elsewhere on this page, and should be carefully read for full details.

In the very nature of the contest it should be obvious that wire must form the largest proportion of the article or model submitted. The more wire that is used in the model, the better its chances for a high prize because the prize is awarded only for the wire construction. Models and articles may be decorated to suit. They may be covered with silk, paper,—the finished model can be painted, gilded or silvered,—the wire may be covered with rubber tubing, or with cord or twine, if the builder so elects. Any of thousands of other ways to finish it up and make it look presentable may be employed. Some articles require a substantial base, as, for instance, that shown under Fig. 16. Such articles are, of course, admissible, but it will be seen that in a model of this kind there is, roughly, 50 per cent. wire and 50 per cent. wood. Consequently a similar article would not win a high prize, because in this particular article the wire would be of no use without the wooden base. Remember that on the wire portions of the model the contest will be judged, but don't make the mistake of using wire where some other substance might be much better. In this case wire could be used as an inferior base material.

We have said before that we wanted novelty, and we mean just that. There is also the possibility, when producing a novel thing in wire, that it is so novel that it can be patented. In this case it should be remembered that publication in any magazine of a national character is a *prima facie* evidence of conception and a patent can be se-

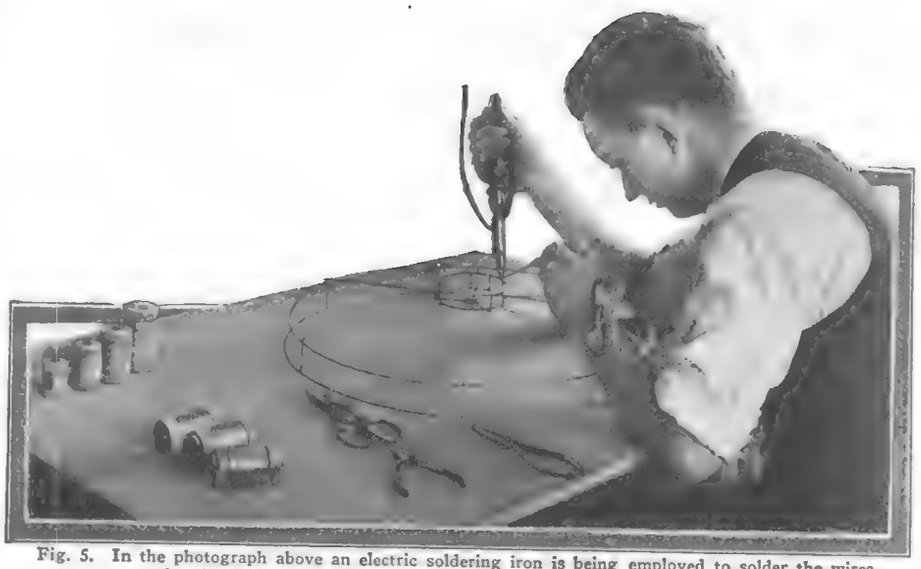


Fig. 5. In the photograph above an electric soldering iron is being employed to solder the wires forming a lamp shade frame together. Wirekraft is a fascinating art.

Rules of Wirekraft Contest

THIS is a wirekraft contest. Hence wire is to be used in the construction of all of the models entered in this contest.

The size of the wire to be employed is limited. The heaviest wire must not be larger than No. 8 American or B and S gauge, and the smallest no smaller than No. 30 B and S gauge—or (for foreign countries not having these exact sizes), the nearest available equivalent. (*No. 8 B and S gauge is .12849 inches in diameter or 3.264 millimeters. Its nearest equivalent in the Birmingham or Stubs iron wire gauge is No.* 18. *In the Stubs steel wire gauge it is No.* 30; *in the British Imperial Standard it is No.* 10. *The nearest wire to No.* 30 *B and S gauge which is .01002 inches or .2546 millimeters in diameter is No.* 31 *in the Birmingham or Stubs iron wire gauge. In the Stubs steel wire gauge it is No.* 80; *in the British Standard it is No.* 33.

The builder may avail himself of the opportunity of using any intermediate sizes of wires between No. 8 and No. 30, B and S gauge.

The wire may be copper, brass, iron, steel, or these materials coppered, tinned, nickel-plated, or galvanized, or the wire may consist of an alloy. Any kind of wire available on the market may be employed.

It is preferable to use non-rusting wires. The publishers will not be responsible for the rusting of any model. To protect wire which rusts easily or for color effects, the models may be painted, lacquered, varnished or otherwise covered.

Any additional decorations or accessories may be employed to enhance the effect. (Example: Silk on a lamp shade; glass in decorative fixtures; electric motors for operating mechanisms, etc.)

Only those portions actually constructed of wire will be judged. (Example: A reed basket is suspended from a wire chain. The basket not being made of wire is NOT considered. On the merits of the chain only will the prize be awarded.)

Wires may be twisted, spliced, soldered, welded or bound together. Wire may be used to bind other wires together. If soldered a non-corrosive soldering flux should be employed.

There is no limit to the size of the models which may be entered nor to the number of entries which any maker may submit during any calendar month.

In every case the model must be forwarded express prepaid to SCIENCE AND INVENTION Magazine. It should be tagged with name and address of the maker, who will prepay charges if model is to be returned.

The first prize will always be awarded to a model possessing the greatest utilitarian merits. This must be an object NOT found on the market today.

The second prize will always be awarded to an object possessing the best decorative artistic or constructive effect. It may be a replica of an existing object or a model of an imaginative object or effect.

All models may remain at the office of this publication until the close of the contest at the descretion of the editors.

This contest starts January 1st, 1927, and will terminate January 1st, 1928.

The remaining prizes will be judged from either one or the other viewpoints at the discretion of the judges.

This is a monthly contest lasting for twelve months, each monthly contest closing on the first of the month following dates of issue. Thus the contest for the month of January, 1927, will close Feb. 1st, 1927. Winners for January will be announced in the April issue.

$3,000.00 In Prizes
Arranged in Monthly Awards

First Prize	$100.00
For Utility Only	
Second Prize	50.00
For Artistic, Decorative or Constructive Effect—may be a replica or model of some imaginative or existing object.	
Third Prize	25.00
Fourth Prize	20.00
Fifth Prize	15.00
Sixth Prize	10.00
Seventh Prize	7.50
Eighth Prize	5.00
Ninth Prize	3.50
10th to 16th Prizes of $2.00 each ...	14.00
Total	$250.00

***Address All Entries to* Editor Wirekraft SCIENCE & INVENTION MAGAZINE, 53 Park Place, New York City**

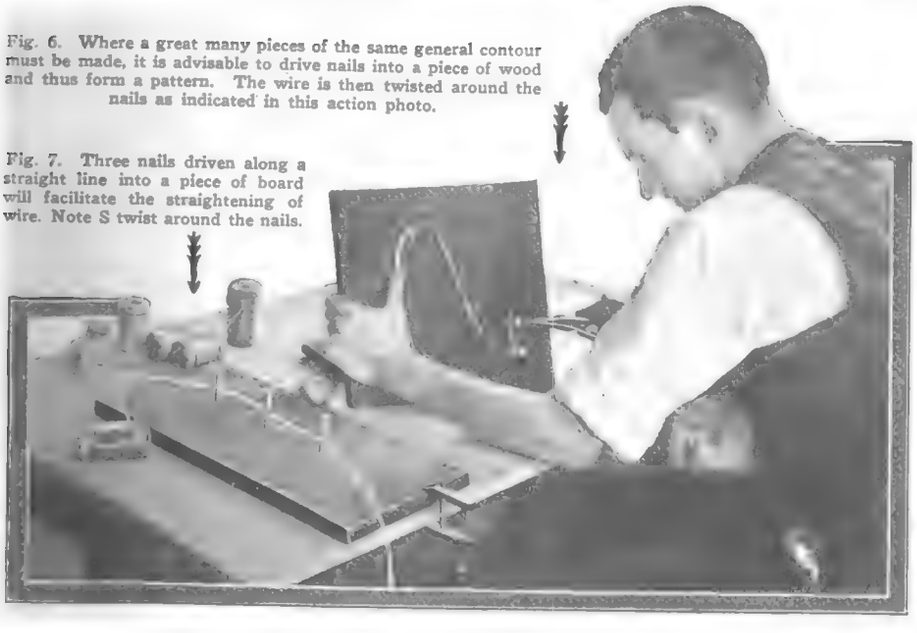


Fig. 6. Where a great many pieces of the same general contour must be made, it is advisable to drive nails into a piece of wood and thus form a pattern. The wire is then twisted around the nails as indicated in this action photo.

Fig. 7. Three nails driven along a straight line into a piece of board will facilitate the straightening of wire. Note S twist around the nails.

"WIRE-KRAFT" $3000.00 In Prizes to be Awarded in this Contest

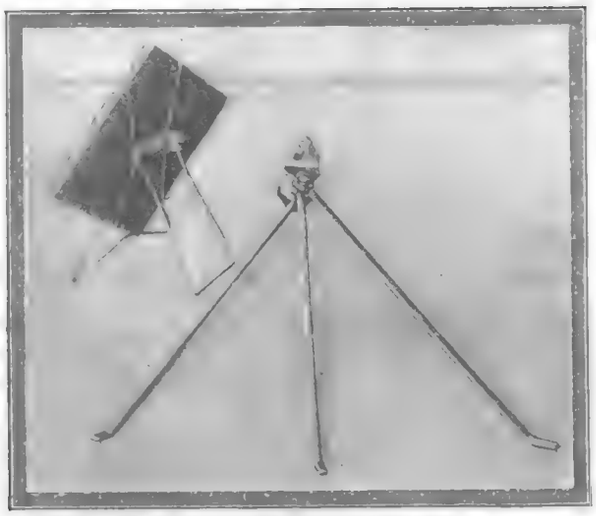


Fig. 8. Above and to the left the photograph shows a simple stand made of wire which is used to hold a square mirror. The other photo shows how wire can be employed to make a clothes drier. The wires in the latter case are preferably heavily nickel-plated.

cured by the builder or constructor within two years after publication in SCIENCE AND INVENTION.

This Wirekraft Contest will naturally be watched with great interest by all manufacturers of such articles in the United States, and the chances are that if an idea is presented of great utilitarian value, the manufacturers would wish to get in touch with the inventor with a view to manufacturing such an article. Publication of such an article in SCIENCE AND INVENTION is therefore an actual protection to the inventor. This should not be overlooked.

The first prize in the Wirekraft Contest will always be awarded to the model possessing the greatest practical and utilitarian merit. It must be an object not found on the market today. The second prize will always be awarded to an object possessing great decorative or artistic or constructive effect.

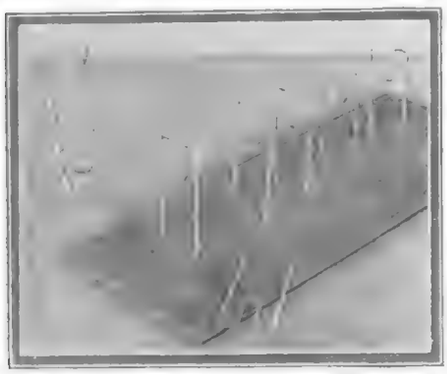


Fig. 9. Two unique wirekraft ideas. One represents a bill file and the other shows a twisted wire form which may be inserted in the drawers of a desk in order to hold letters in place. The system is also suitable for a letter file.

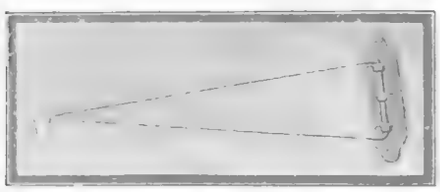


Fig. 10. A rather simple yet unique bird-cage hook is depicted in the photo above. The bracket is not made of wire, therefore would not be considered by the judges.

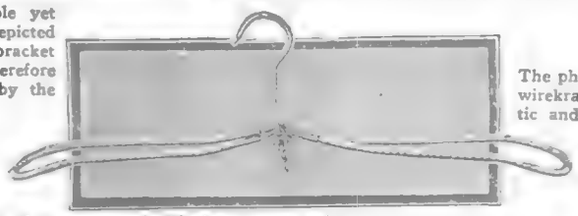


Fig. 11. The photo at the right shows a cloth covered coat hanger made of wire.

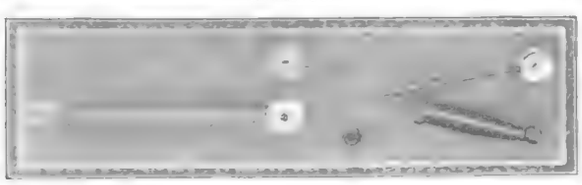


Fig. 12. Spring wire is of course permissible in a contest of this nature. The photo below shows two types of springs for radio antennas and three eyelets also made of wire, the ends of which are provided with threads.—Courtesy Parker Metal Goods Co.

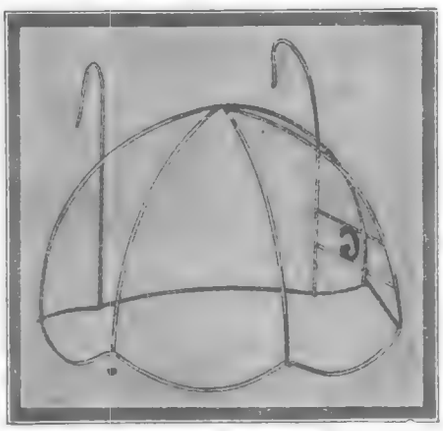


Fig. 13. This photo shows another of the possibilities of wirekraft. The frame is intended for a boudoir or bed lamp which may be covered with silk if the builder so desires. The wire portion of the model only will be judged.

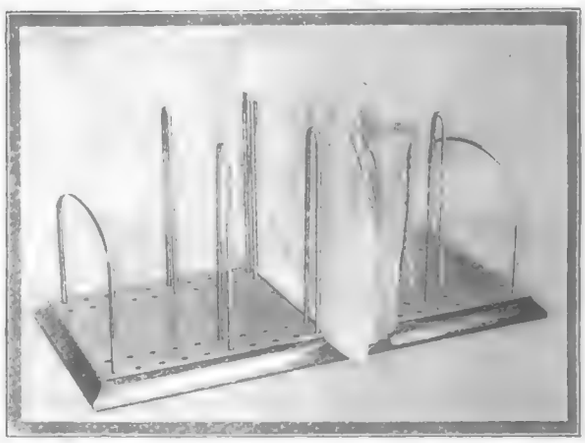


Fig. 16. Here is a unique letter file also made of wire, but in this photo the baseboard is of wood. The same base could also have been composed of wire but the device would then be not quite as practical and infinitely more difficult to construct.

The photos on this page show wirekraft ideas of both artistic and utilitarian properties.

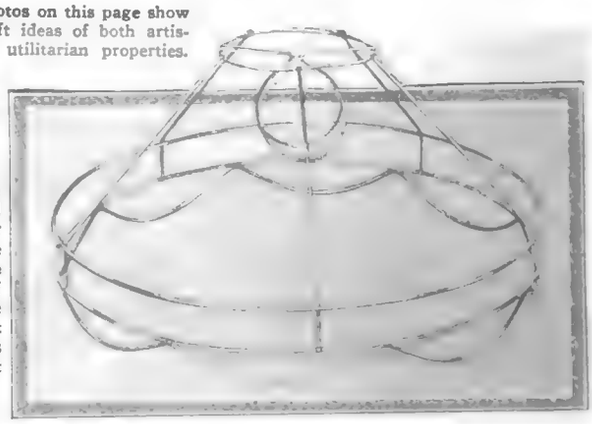


Fig. 14. Here is a unique wire frame also intended for a boudoir lamp or wherever a small size lamp is indicated. Note the scalloped bottom of the frame and also the double circlet of wire at the top which clamps around the incandescent globe.

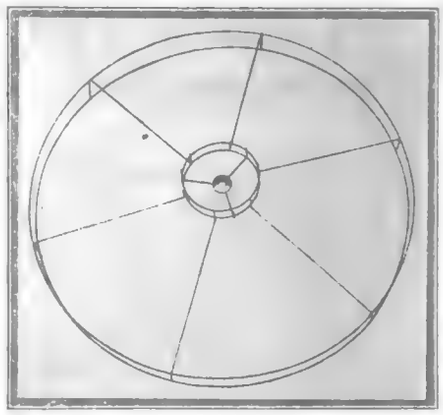


Fig. 15. A simple large shade for a piano lamp is indicated above. The small metal circlet in the center fits over the top of the piano lamp stand and is there locked in place by a nut.

It may be a model of the Brooklyn Bridge, of the Woolworth Building, the Eiffel Tower, or any public building that you choose to build. Making a building, for instance, it is allowable to use isinglass or celluloid for windows and other adjuncts, to make the article presentable, in order to make it a true replica of the original. Motors can be used to operate mechanical devices and small lamps or clocks may be placed in buildings or other constructions to enhance effect.

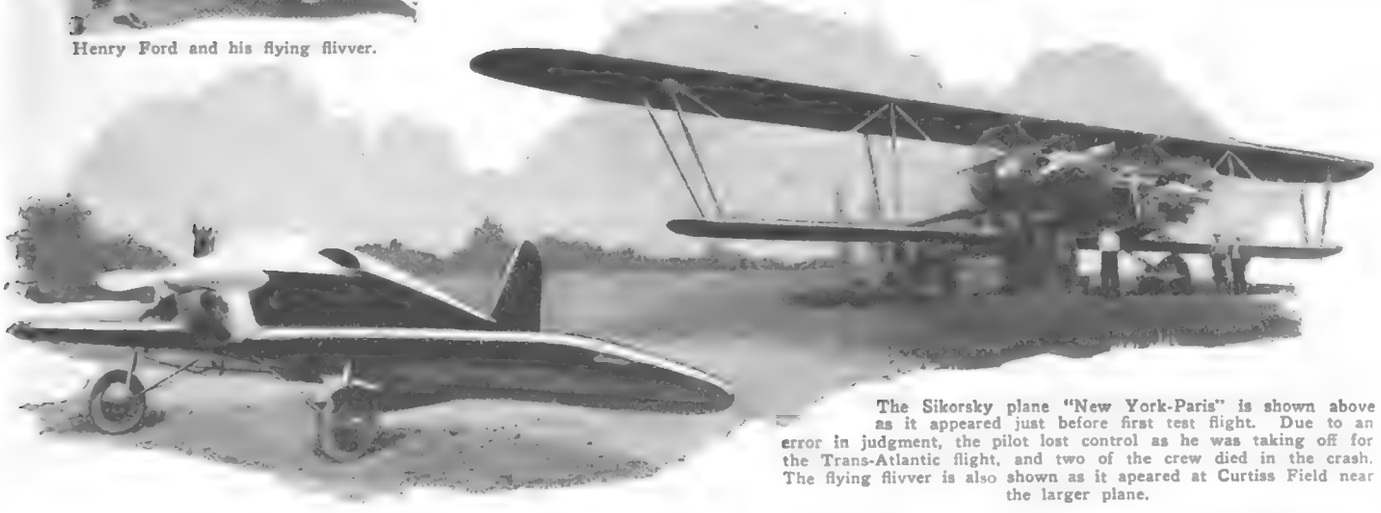
Any size wire within the limits shown in the rules can be used. The wire that SCIENCE AND INVENTION recommends is clean bright wire, either tinned, galvanized, coppered or nickeled, because this is non-rusting. Any other wire, however, can be used at the option of the builder and the wire may afterwards be covered by varnish, paint, or any other method elected by the builder. Spool

(*Continued on page* 759)

Now the Flying Flivver

HENRY FORD, world-famous as the manufacturer of the well-known "flivver", recently announced the perfection of a small, easily housed airplane which is expected to be the first of a series of developments in popular aviation. The "flying flivver" has a wing spread of 18 feet, it is 12 feet from propeller to rudder, and weighs only 300 pounds. Powered with a 3-cylinder Anzani motor, it is capable of a speed of over 100 miles an hour. Mr. Ford is shown at the left explaining the operation of the "baby plane" to visitors at the Dearborn plant, while below the plane is seen in comparison with the ill-fated Sikorsky bi-plane in which Fonck had intended to fly from New York to Paris.

Henry Ford and his flying flivver.



The Sikorsky plane "New York-Paris" is shown above as it appeared just before first test flight. Due to an error in judgment, the pilot lost control as he was taking off for the Trans-Atlantic flight, and two of the crew died in the crash. The flying flivver is also shown as it apeared at Curtiss Field near the larger plane.

Bicycle Propelled by Arms

GERMAN inventors seem to be concentrating upon hybridizing rowboats and land-vehicles. A few months ago we published the photos of the four-wheeled "Rowmobile", which seemed to interest our readers, and now we present a bicycle which is propelled through a series of gears by a rowing action of the arms. We are unable to obtain the name of the inventor of this machine and its manufacturer is also unknown.

Above the "Row-cycle," as it apears in the operating position. The steering is controlled by means of pedals, and the seat slides in a fashion exactly like that of a racing boat. At left, the method of propulsion is seen to consist of a series of belts connected so as to transmit a continuous forward motion through a chain to the rear wheel.

Water Shoes Offer New Sport

Steuerlein, an engineer of Schweinfurth, Germany, has invented a new "water shoe," intended for sport purposes. The photo at the right shows the inventor demonstrating his device. The apparatus is controlled by the levers which he is holding, and is actuated by leg power. Every step made throws the paddles into action with an oar-like motion.

Free Cathode Rays*

Dr. W. D. Coolidge, of the General Electric Company, Makes Remarkable New Discoveries with Free Cathode Rays in Air

By G. C. B. ROWE

Dr. W. D. Coolidge, the physicist, who has developed a vacuum tube through the end of which cathode rays pass into the open air.

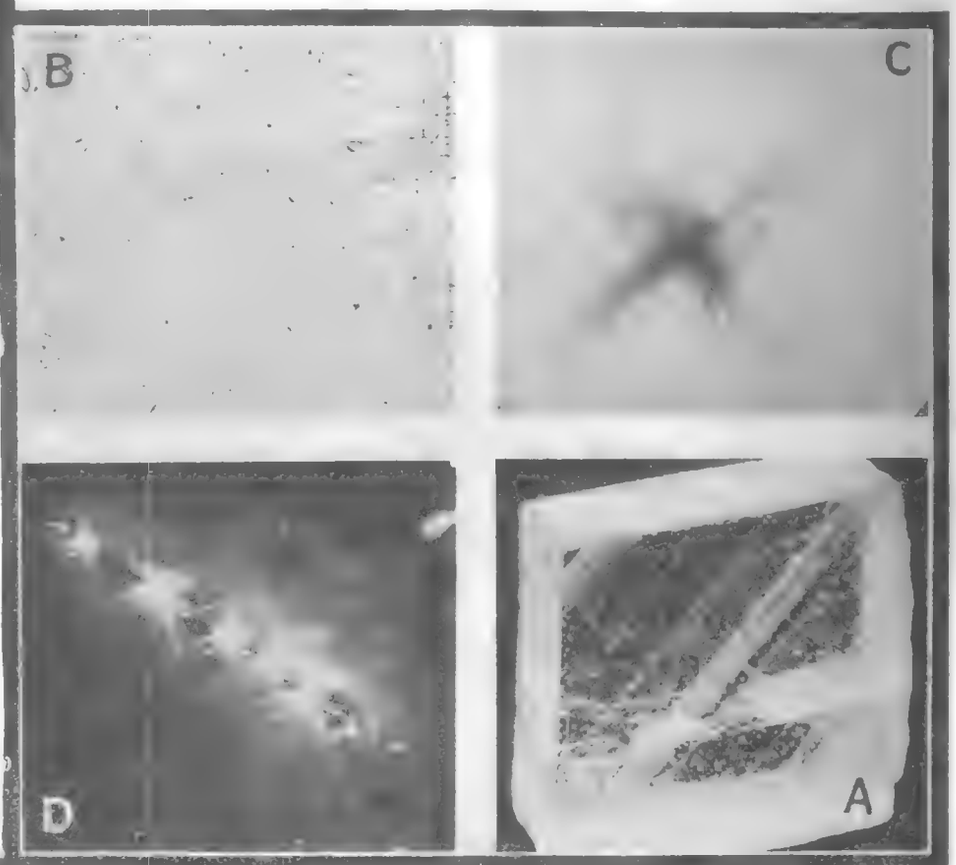


Fig. 8A. This block of Iceland spar (calcite) was exposed to the influence of cathode rays and retained its orange glow for several hours. Also there were minute bluish sparks, which after the first flash showed black against the orange glow. (See Fig. 8B.) These black spots proved under microscopic examination to be minute craters, connected by canals running at right angles to each other and parallel to the surface of the crystal. An enlarged photograph of one of these craters is reproduced in Fig. 8C. Fig. 8D is a microphotograph of the sparks occurring under the influence of the cathode rays.

In Fig. 10 (left) is shown the ear of the rabbit with the round scab, which formed a few days after the ear was rayed. Fig. 11 shows this same ear after two weeks. In that time the scab came off and white hair grew in place of the ordinary gray hair.

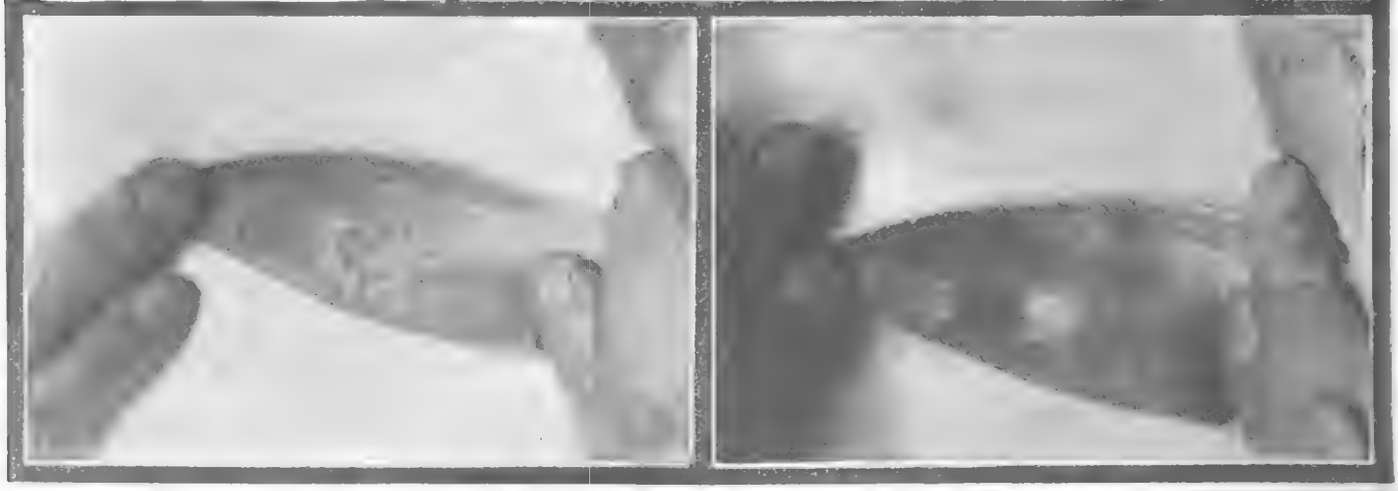


FIG 1

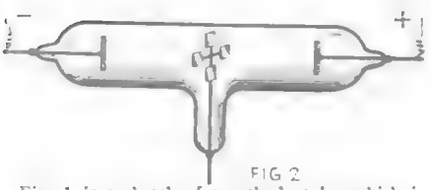


FIG 2

Fig. 1 is a sketch of a cathode tube, which is the simple form used by Crookes in his early experiments. The negative terminal is the cathode and the positive one the anode. In Fig. 2 a small easily-turned windmill was inserted in the path of the cathode rays, the speeding electrons of which caused the mill to revolve.

CATHODE rays have been the subject of a vast amount of research for scientists ever since Sir William Crookes discovered their presence in a glass tube from which most of the air had been removed, and through which he passed a high voltage electric discharge. Their characteristics and behavior within the evacuated tube were studied by Crookes and others but the Hungarian physicist, Philipp Lenard, succeeded in making them flow through a small, thin metal window into the surrounding air where they could be more conveniently utilized. Until recently, the output of such tubes has been very

* The material for this article was taken from a paper read before The Franklin Institute, on October 20th, 1926, by Dr. W. D. Coolidge, of the Research Laboratory of the General Electric Company. Acknowledgement is hereby made to The Franklin Institute for the use of the various illustrati

Fig. 4 shows the purple glow of the rays beyond the tube's end.

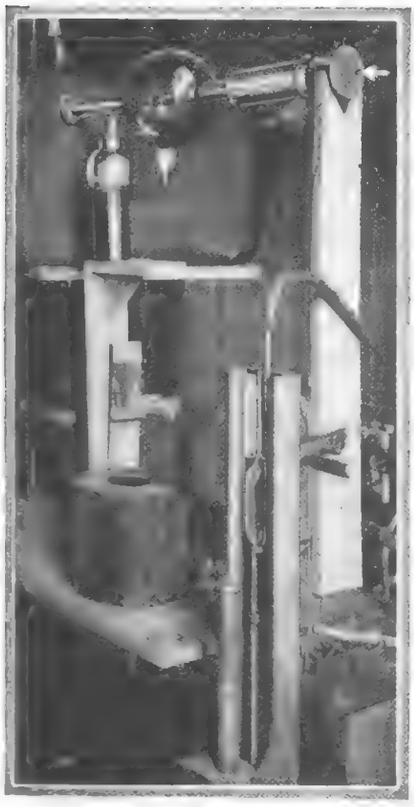
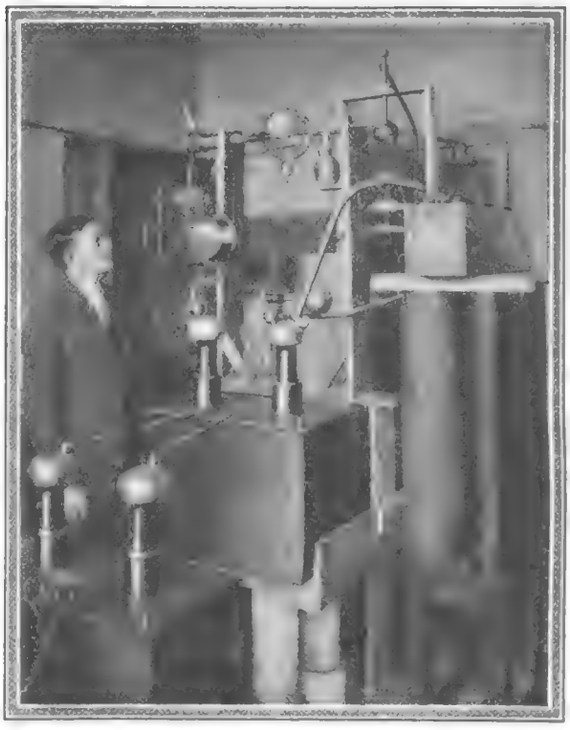


Fig. 6 at right shows the remarkable new tube developed by Dr. W. D. Coolidge in the General Electric Co.'s research laboratories, which tube is capable of producing powerful cathode rays outside the tube.

Fig. 7 at left shows close-up view of new cathode ray tube, the arrow pointing to the window at end of tube, through which window the free cathode rays are projected outside the tube in considerable quantity.



that a discharge from the cathode or negative terminal still continued. He gave this radiation the name of "cathode rays." He discovered that metallic plates placed within the vacuum tube (see Fig. 2) intercepted the cathode rays, and that the impact of the rays against the glass walls of the tube produced a greenish fluorescence and phosphorescence, accompanied by an increase in temperature. Various substances placed in the path of the ray fluoresced brilliantly. He also noted that the cathode rays were deflected by a magnet. Crookes spoke of this gaseous discharge as the "fourth or radiant state of matter." Later investigations have shown it *to be composed simply of a stream of electrons or minute particles of negative electricity.*

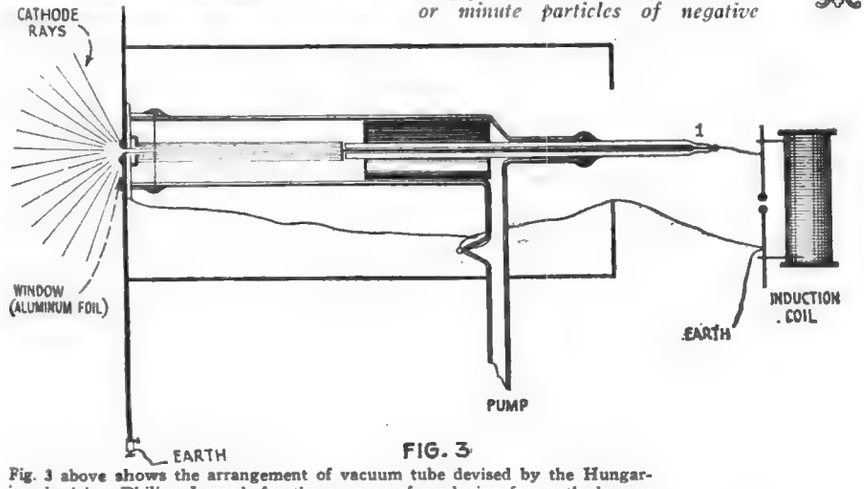


FIG. 3

Fig. 3 above shows the arrangement of vacuum tube devised by the Hungarian physicist, Philipp Lenard, for the purpose of producing free cathode rays outside the tube. Lenard was handicapped in many ways and Dr. Coolidge has, with the aid of modern apparatus, built a powerful cathode ray generator.

limited, due to the relatively low voltages and currents at which the tubes could be operated and to the window structure employed. Due, however, to the efforts of Dr. W. D. Coolidge, well known for his work on various types of vacuum tubes, the scientific world today has a cathode ray tube capable of delivering through its window a much greater quantity of electrons at velocities which are producing new and startling results.

Let us consider for a moment the nature of cathode rays. Professor Crookes found that, in a tube, such as is shown in Fig. 1, containing two metal electrodes connected to a source of high voltage current, the luminous Geissler glow disappeared if a sufficiently high vacuum was obtained, but

Hertz announced in 1892 that cathode rays would penetrate gold leaf and other thin sheets of metal when placed within the tube and, as has been mentioned previously, Philipp Lenard was later successful in getting them to come through the end of the tube in which they were generated. A sketch of the tube which he used is shown in Fig. 3. On the right is indicated an induction coil. The negative side of this coil is connected to the terminal, 1, which is the end of the cathode, or negative electrode, and the other side is connected to the window. This window is the interesting part of the tube, for it is through it that the ray travels into the open air. Lenard used aluminum foil as a window. The foil, about an eighth of an inch in diameter, and one ten-thousandth of an inch thick, was cemented to a perforated brass plate attached to the end of the glass tube. The foil was selected by microscopic examination to obtain an area free from minute holes.

Lenard was handicapped by the melting point of the wax joint between window and tube, by the smallness of the window and the comparatively low voltages employed.

Other investigators have worked with and further developed the Lenard tube and have somewhat increased its output. In all of their work, however, it has been necessary to have the tube during its operation connected to the exhausting system. Dr. Coolidge's contribution to the art has been the development of a tube capable of being sealed off from the pump and of being operated at voltages as high as 350,000 and delivering a greatly increased quantity of energy through the window.

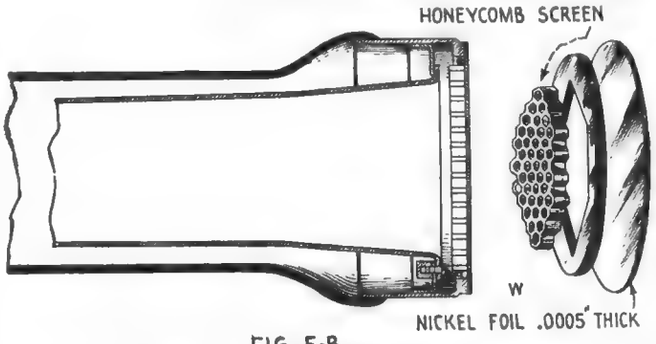


FIG. 5-B

Fig. 5-B above shows a close-up sectional view of the window in the Coolidge cathode ray tube. The thin nickel foil permits a vacuum to be established, thanks to the support of the honeycomb screen.

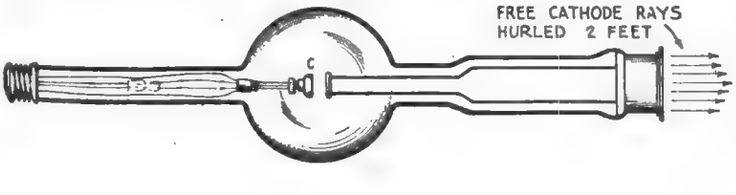


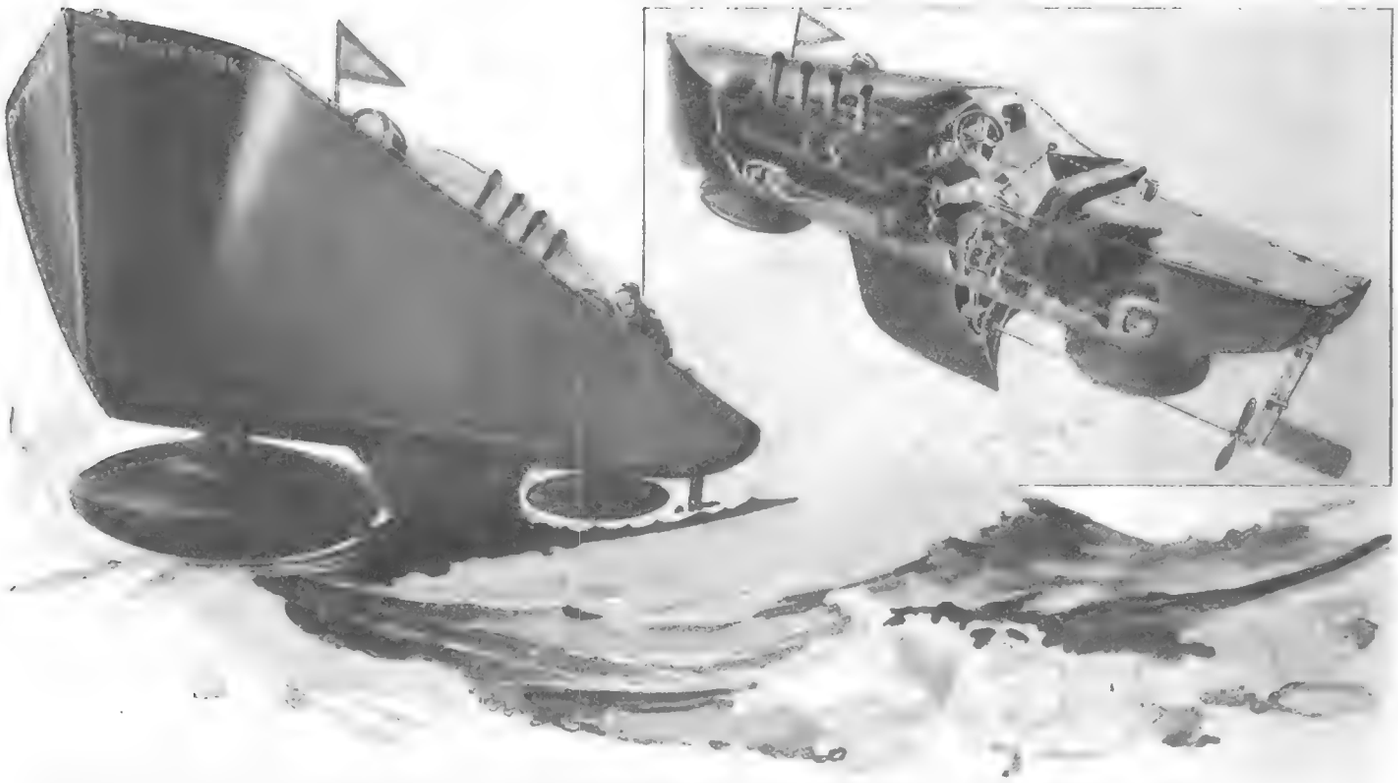
Fig. 5-A at left shows general view of the Coolidge cathode ray tube and how the free cathode rays emerge.

THE CONSTRUCTION OF THE NEW TUBE

In Fig. 5 will be found a sketch showing the main parts of this tube. At the left in Fig. 5A is an ordinary lamp screw plug, through which is supplied the current, which

(*Continued on page* 728)

The Fastest Boat In the World?



Our illustration shows a new construction of a boat patented by Hans Becham. The design is based upon the fact that hollow lenticular bodies convex on the bottom, immersed in water, lift themselves out of the water as soon as they are set in rotary motion. The drawing shows a vessel with two such lenticular bodies susceptible of rotation about the vertical axis. As soon as these floats are set into rotation, the hull of the boat rises from the water. Inasmuch as the drag of the water at full speed is extremely small, the resistance to the motion of the boat is very slight, so that with a proportionately small development of power, a very high speed can be obtained. The phantom diagram shows the mechanism of the vessel. Note that the propeller extends from a shaft passing through the keel of the vessel. The keel, propeller and a rudder only are submerged.

The Astrology Humbug

By JOSEPH H. KRAUS

SINCE the last two articles on Astrology were written, the editors have received a great many letters from astrologers and astrological students. Regardless of what we may say about astrology, we must certainly admit that the students of astrology at least rally to the standard of their favorite subject while it is being battered and torn. This same statement does not hold for most of the astrologers who are looked up to as leaders in the field. While we have received many communications from students of astrology as well as from a few astrologers, those who are well known in the field have not requested the data on the birth dates and locations of several of the test cases which we have on hand and upon which $1,000.00 is being placed.

Judging from the letters, it is plain to be seen that even the astrologers themselves do not know their subjects. One astrologer will state that it is impossible to forecast events or calamities over which the astrologer has no control and another group of astrologers will then analyze the events likely to occur in a day, week, month or year. We have all seen forecasts for the month and we have all seen the astrological forecasts for a year. These find space in our daily newspapers and in our Sunday feature editions just before the new year comes into being.

There is one group of astrologers that desires the date of birth. There is another group of astrologers that request the time of conception and that disregard entirely the dates of birth. How this latter factor can possibly be given is difficult for us to ascertain because the exact moment of conception cannot possibly be known by even surgical methods. The most that a physician can do is to approximate this time. Under the circumstances it would appear that the latter group of astrologers could not develop an accurate horoscope yet this remains to be seen.

In a clipping before us we find according to a horoscope that "President Coolidge is now entering one of the most evil cycles of his career. There is much sorrow for both our President and our Government, as well as for most all high governmental officials."

In another horoscope also before us we find "The good influence of Venus favors the popularity of the President and his cabinet and brings social activity and merry-making into this department of the National life."

Both horoscopes were cast by different astrologers. Can it be that even they do not know how to read the signs of the planets? Of course, it can be easily argued that there may be good leaders as well as incapable workers in the field. How are we to know unless some of the astrologers who are looked up to by the students take advantage of the awards which we offer.

One group of astrologers will tell us that the lower animals are not affected by planetary influences, but only thinking individuals are affected. Another group state that animals are affected, but their reactions are different and consequently we cannot observe the difference.

To emphasize the fact that only thinking individuals are affected by the planets, some astrologers say "that the stars incline but cannot compel" and that "a wise man rules the stars, while a fool obeys." Now if a thinking individual is affected by planetary influence,

(*Continued on page* 747)

$6,000.00
For Proofs of Astrology

SCIENCE AND INVENTION Magazine holds that there is nothing scientific in Astrology, that Astrology is not a science and that statements made by astrologers unless very general cannot be entertained seriously.

Accordingly, this publication has decided to award an Astrology Prize of $6,000 for the following:

$5,000 will be paid to the astrologer or forecaster who will foretell three major events of such a nature that he will have no control over the outcome of the same. He must describe in advance each event in detail, giving the location and result or the casualties if the event is an accident.

$1,000 will be paid to the astrologer or forecaster who will produce three accurate, detailed and perfect horoscopes, free of contradictions on the lives of three people whose initials will be given him when he requests the same and the birth dates and place of birth will also be supplied by this office.

This contest closes October 1st, 1927, and all entries must reach us by that time. In event of a tie, prizes of an identical nature will be given those so tying.

Address all entries to Editor, Astrology, care of SCIENCE AND INVENTION Magazine, 53 Park Place, New York, N. Y.

Our Spiritualistic Investigations

By J. Dunninger.

NO. 5 OF A SERIES

"We were asked to place our fingers lightly upon the table-top . . . Several moments elapsed . . . lift your hands into the air and in the name of Allah, I command the spirits to cause the table to rise. . . . and the table did rise."

INDIA is the home of mystery. Ghostly things and creepy experiments galore have been unfolded from the shadows of the East. Hindu fakirs have startled civilization, Yogis have mystified the natives, from the land of the turbaned-worshipers come beliefs of ancient products, such as East Indianism, Occultism, Yogiism, East Indian psychology, and other titles enwrapped in mystery. Yet strange as it may seem, Hindu spiritulists are rare. One, however, I have recently unearthed . . . Rajah Hassid, "The Spirit Force, from the East," as he terms himself. A suave, well mannered fellow . . . short in stature, characteristic in appearance. Always seen in the dress attire of the European, yet his dark skin, piercing eyes, lacquered black hair, and large Oriental jewelry, leave nothing to the imagination. He is a Hindu, and almost abuses his mystic privileges, as the many powers he admits possessing, would almost credit him with being a reincarnated subject, referred to in the ancient days of Biblical history. Rajah Hassid mingles in high society, and has upon his mailing list, names of persons prominent, as well as those of quite a number of celebrities. Conversing, as he does, in several languages, and pleasing to the studious, thanks to his ability as a conversationalist upon mystic topics in general, he has many followers. His work is mostly readings from the gardens of the dead, and although an Orientalist, his spirit guide seems to have a key into the land where the souls of European races dwell, as he can call forth spirit messages, for any and all. Of course, the Rajah gives seances as well, but only to those recommended to him. During the summer months, the limousines of many leaders of society can be found parked in front of his abode in Newport. Tea is served in the waiting room, and all those conveniences, to which his clients are accustomed have been well considered. These spirit meetings are conducted only for these invited guests, and there is no charge, as it is his form of advertising. Astounded at his demonstrations, new clients are easily made, and private readings for these proved sufficiently profitable to well afford his apparent generosity at his occasional exhibitions. It was one of these meetings that I was invited to attend. My host at this occasion therefore presented me in person to the Rajah, and although using a ficticious name so as not to disclose my identity, unfortunately described me as a fellow student of the spiritual. This introduction caused me quite a bit of uneasiness, as the medium at once opened conversation upon general spiritual topics, which it seemed was done particularly for the benefit of the bystanders. This was rather embarassing to me, as I could not very well analyze my view points, without disclosing the fact that I was a disbeliever, and present at the meeting, only to discover the *modus operandi* of his methods. I therefore posed as a rather gullible subject, and was obliged to accept an array of unsually well rendered conversation, which he gladly volunteered. An Oriental attendant relieved my agony, after but a few moments of controversy, as he interrupted, asking the Rajah's permission to usher the guests into the seance room. The mystic excused himself, and offering me an invitation to continue our conversation after the seance, he left me, and quickly vanished behind a set of deep colored, thickly woven, Indian portiers. Several moments later, the gathering was ushered into another room, which was furnished in exceptionally good taste, with slight sugges-

(*Continued on page* 752)

$21,000.00 for Spirits

Dunninger, who writes exclusively for SCIENCE AND INVENTION Magazine and who is the Chairman of our PSYCHICAL INVESTIGATION Committee will personally pay $10,000.00 to any medium or spiritualist who can present any psychical manifestation in so-called spiritualism, that he will not explain or that he cannot reproduce by natural means.

More than two years ago SCIENCE AND INVENTION Magazine offered a prize of $11,000.00 to anyone who could demonstrate his or her ability to communicate with the spirits or to give some definite form of a psychical demonstration which in itself was not trickery.

The result has been that mediums and spiritual organizations have been afraid to place proofs before us. Those weak attempts which have been made to demonstrate psychical phenomena were almost instantly proven fraudulent, and no medium has dared to contradict our findings.

In view of these facts, should we not consider all mediums fraudulent? Should we not consider every psychical manifestation as being trickery pure and simple, intended primarily to fleece those who visit the circle and who find solace in the words from the worst forms of charlatans, namely those who are being permitted to practise upon the poor, seeking words from loved ones?

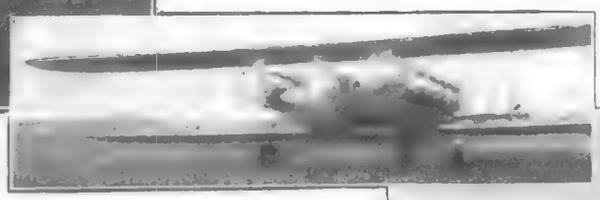
To the $10,000.00 which has been offered by Joseph F. Rinn through this publication for Spiritual proofs and the $1,000.00 in addition offered by SCIENCE AND INVENTION Magazine we now add Dunninger's $10,000.00.

So now we have a total of $21,000.00 offered for proofs of Psychical Manifestations. Spiritualists—get busy.

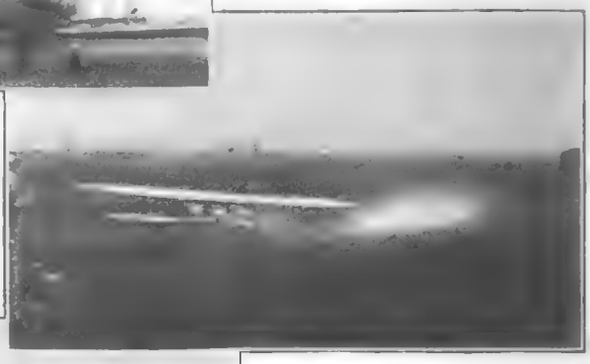
WHY THE SIKORSKY TRANS-ATLANTIC

"Movie" camera reveals details of accident which destroyed Fonck's hopes of New York-Paris flight

The plane appears to move somewhat sluggishly as it comes down the runway, due no doubt to the fact that it is loaded far in excess of its normal capacity. This photograph shows the plane at about the middle of its one-mile dash from the hangar to the edge of Curtiss Field.



The plane wobbles a bit as it roars past the photographer stationed at the brink of the embankment on the edge of Curtiss Field. It appears certain that the plane cannot rise.



The plane shoots down the embankment and the right wing-tip grounds as it bumps across the rough field. The roar of the motors ceases as Fonck throttles down in an attempt to stop.

A cloud of dust arises as the right wheel drops off and the lower wing begins to crumble. The machine skids along at fifty miles an hour and begins to swing around to the right. The cameraman continues to grind as the wreck seems inevitable.

The tail of the plane rises and the nose goes down as it spins around on the crushed wing-tip. The entire incident covered a period of only a few seconds, hardly giving the spectators time to realize what was happening.

The wing folds up and the plane crashes over on its back. Fonck and Curtin, who were in the control cockpit, were thrown clear, but the blaze which followed a few seconds later caught the radio operator and mechanician, who were instantly killed by the shock of the crash.

The gasoline soaked fabric disappeared instantly, but the fuel continued to blaze for fifteen minutes. The tremendous heat created caused the motors and frame to be welded together, and the molten aluminum flowed along the ground like lava.

AT 6.32 A. M., Tuesday, September 21, 1926, a giant Sikorsky biplane designed to be the first to fly from New York to Paris stood with motors roaring, ready to begin the great adventure. The plane had been carefully loaded with a tremendous cargo of gasoline and oil, sufficient to fuel it for the trans-oceanic flight, and the motors were tuned up in anticipation of the arrival of the crew of four who were risking their lives for the thrill of being the first to get across. Just as the rising sun began to brighten the horizon, Charles Clavier, radio operator, and Jacob Islamoff, mechanician, entered the cabin of the great silver bird.

There was delay. The hum of the engines died. Then an automobile drove up and stopped with a screech of brakes. Rene Fonck and Lieut. John Curtin jumped from the tonneau and hurried to the plane.

The engines roared in a crescendo of impatience. With a gay flip of his hand and a smile toward Sikorsky and his workers, Fonck opened the throttle and was off.

Rapidly the plane darted down the runway. There was a great cheer. In a moment the crowd became silent with wonder and pride.

Then there was a gasp.

Halfway down the long runway the plane paused for a moment in its swift, sure glide. It raped sideways, hovered for a moment, and landed with a sudden increase in speed to the end of the take-off.

Transfixed with the uncertainty of a dawning fear, the crowd stood still as the plane lifted itself into the air. It plunged and lurched for a terrible second.

Nose down, the plane dove thirty feet off the end of the runway. A puff of smoke whirled from the plane as it plowed crazily for 300 feet over the rough ground.

Then suddenly, the plane tilted and the right wing tip struck the ground. The machine swerved, raised a cloud of dust and crashed over [illegible]. Fonck and Curtin were thrown from the cockpit as the plane settled in a mass of tangled wreckage.

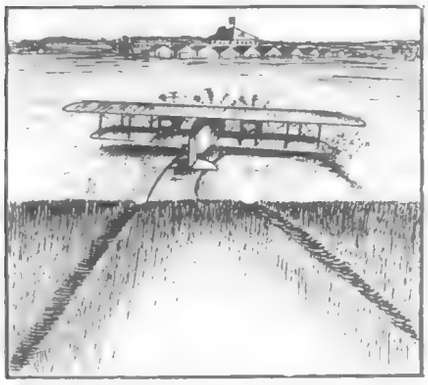
There was a moment of deathly silence, then a blinding flash of flame as the fuel from the broken tanks spurted on the red hot manifold. Few minutes later, the framework and motors were a twisted mass of shapeless steel, and the flames had set as a funeral fire to the two unfortunate [illegible] who were trapped in the crushed fuselage.

That is the story of the failure of one of the most ambitious plans conceived by any man in this age. Many reasons have been assigned as a cause for the accident. Some say [illegible] Fonck [illegible] greatest night [illegible] he manipulated the controls. Others said there was a mechanical defect in the plane or undercarriage. Still others said the giant bird was overloaded; we, forced to form our opinion at second hand, reserve decision, but we are able here to present the entire incident in pictures so that perhaps you may be enabled to pass judgment.

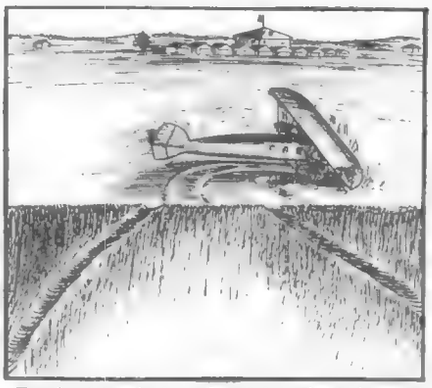
The series of photographs on this page, which by the way you will not find published anywhere else, are a tribute to the presence of mind of Herman Stockhoff, International News Reel photographer, who kept on cranking his camera when the other photographers were too amazed to do anything but gasp. These photographs were enlarged especially for us from his news reel strip.

The editors attended several showings of the various news reels covering the accident and consulted with the staff of the *Daily News*, with a view to discovering, if possible, the cause. Some of the details are rather obscured in these photographs, due to unfavorable light, so the sketches on the opposite page may make the events a little clearer.

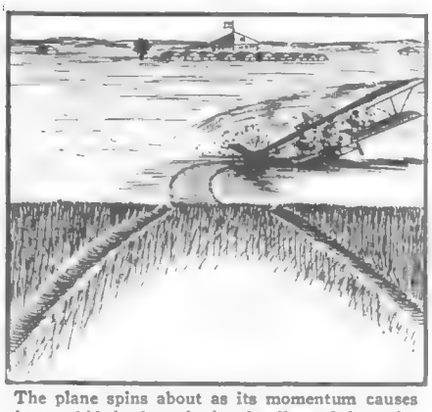
PLANE FAILED TO CROSS OCEAN



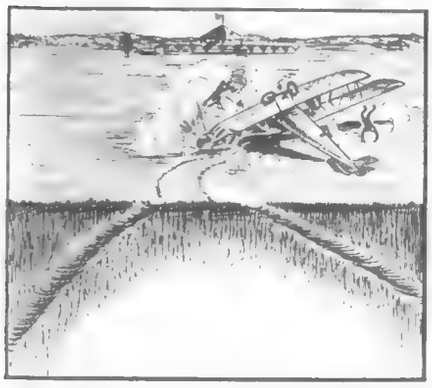
The drawings reproduced here were made by our artist to illustrate more clearly the details of the accident. This sketch corresponds approximately to the third photo opposite.



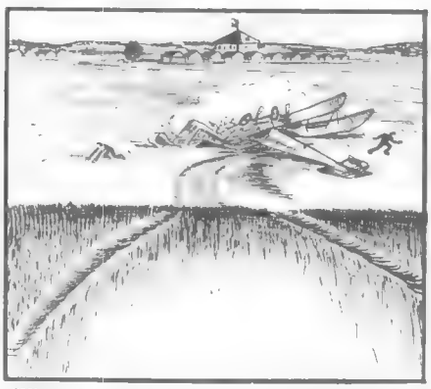
Fonck claimed that the right wheel dropped off, causing him to lose control. This wheel was found in the same place as the rest of the wreckage. See the fifth photograph.



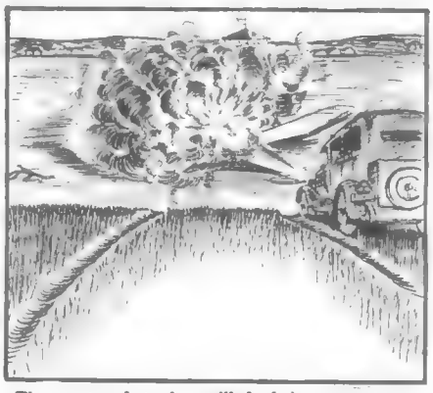
The plane spins about as its momentum causes it to skid backwards in the line of its original direction. Dust clouds rise, hiding the details from most of the observers present.



The momentum causes the nose of the plane to rise and it crashes over backwards, throwing the pilot and navigator to some distance and completely crushing the fuselage.



When the wreck had ceased crumpling, it lay still for several seconds as the two dazed men rose to their feet and looked back at the destruction they had escaped.



The ruptured tanks spilled their contents on the hot motors and manifold pipes and the wreck burst into rocketing sheets of flame as the observers raced toward it.

$41,000.00 IN PRIZES

Offered by Science and Invention Magazine

$21,000.00 is offered by this publication for proofs of spiritualism. The editors of SCIENCE AND INVENTION Magazine do not believe that any authenticated cases of spirit manifestations or phenomena have ever been produced. They hold that all spirit phenomena are fraudulent in nature and that those organizations which try to entice people into their circles to ostensibly listen to messages from beloved ones who have passed from this world into the next are carrying on a fraudulent game which is more harmful than good. This publication does not mean to infer that legitimate forms of religion are harmful. Its fault is only with that form masquerading under the guise of "spiritualism" and purporting to give messages from the spirit world. See page 693.

$6,000.00 will be given by this publication for proofs of "astrology." SCIENCE AND INVENTION Magazine holds that there is no truth in astrology, and that it is not a science and that statements made by astrologers, unless they are very general, cannot be seriously entertained. This publication will, therefore, pay $5,000.00 to the astrologer or forecaster who will foretell three major events of such a nature that he will have no control over the outcome of the same, and who will describe in advance each event in detail, giving the location and the result or the casualties if the event is an accident. This journal will also pay $1,000.00 to the astrologer who will produce three accurate and perfect horoscopes of individuals whose initials and dates of births will be supplied to him. For further details, see page 692.

$5,000.00 will be paid by this publication during the fiscal year for models built entirely of matches. The entire construction of these models must be of the wood of matches, the heads of which should preferably be cut from the wooden sticks. Although this contest was primarily intended for shut-ins, it is not limited to those unable to get about other businesses. Full details of the contest as well as this month's prize winning contestants and the models which they built are to be found in this issue on page 703.

$5,000.00 will be paid by SCIENCE AND INVENTION Magazine to the individual or individuals who will demonstrate a working model of a perpetual motion machine at the offices of this publication. This magazine does not believe that perpetual motion is possible, and this award is primarily made as a protection for those who would invest in constructions of this nature. Many times a would-be perpetual motion inventor will tell prospective investors that he needs just a few more dollars to patent his invention, that his machine is the only one which will operate, and that it has received recognition in the scientific world. The story told in present-day circles is that the inventor has collected millions of dollars for his system from any one of the large automobile manufacturing concerns. Under the latter circumstances, the inventors claim to do investors a favor by permitting them to invest. Those telling the first story will patent the invention as soon as they get the additional funds. To both of them the editors say that they will pay them $5,000.00 when they merely exhibit a working model of the device. We desire no rights to the invention whatsoever.

$1,000.00 and more is being paid every month by SCIENCE AND INVENTION Magazine to its authors. Articles are all paid for, except those written by our staff.

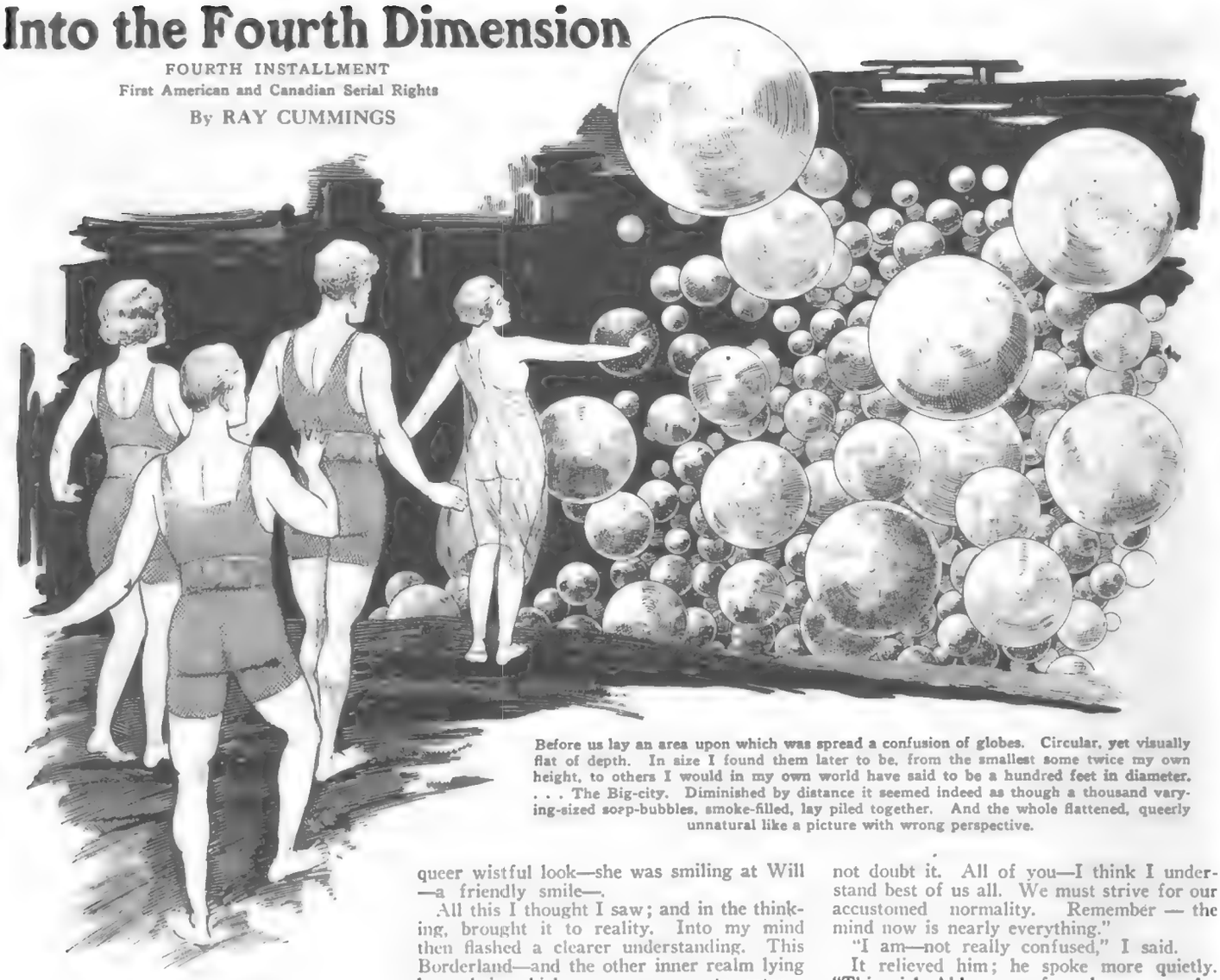
$3,000.00 will be paid during the fiscal year for "Wirekraft" models. This is a new contest inaugurated by SCIENCE & INVENTION Magazine, and the conditions of the contest will be found on page 686 of this issue. Get busy!

Into the Fourth Dimension

FOURTH INSTALLMENT

First American and Canadian Serial Rights

By RAY CUMMINGS



Before us lay an area upon which was spread a confusion of globes. Circular, yet visually flat of depth. In size I found them later to be, from the smallest some twice my own height, to others I would in my own world have said to be a hundred feet in diameter. . . . The Big-city. Diminished by distance it seemed indeed as though a thousand varying-sized soap-bubbles, smoke-filled, lay piled together. And the whole flattened, queerly unnatural like a picture with wrong perspective.

CHAPTER VII

THE STRUGGLE AT THE BORDERLAND

THE thing stood waiting as Will drew us toward it. Fear swept over me. Yet the very sense of fear brought with it a reassurance, for it was the physical I feared; the vanished sense of my body was not entirely gone, for now I was fearing its welfare.

My voice protested, "Will. Wait. That thing there—"

"It is friendly, Rob."

The fear died. I remembered what now seemed obvious; Will had been leading us somewhere with a set purpose. To meet this friendly thing, of course; this thing which doubtless he had met before. I stared at it as we approached. A dim, opaque grey shape like ourselves; but it seemed formless, sexless; neither human nor unhuman—a shape merely—a something poised there of which my mind seemed able to form no conception. Then I heard Will say to Bee.

"A girl, Bee—you understand—Rob, listen. We must cling to the realities of our world. There are no other words—no other conceptions—with which we can think these unthought things. This is a girl——"

I thought it was a girl; and at once I fancied that I could distinguish her. Standing there with a phantom barn and haystack of our own world above and behind her. A girl like Bee. I could see the grey-formed outlines of her; vaguely flowing draperies; long hair; a face of human beauty with a queer wistful look—she was smiling at Will—a friendly smile—.

All this I thought I saw; and in the thinking, brought it to reality. Into my mind then flashed a clearer understanding. This Borderland—and the other inner realm lying beyond it which soon we were to enter—could no more be compared to the world we had left than an apple can be added to an orange. The very essence of every thought we now were thinking was different—incomparable. Yet within our minds was some lingering, unchangeable quality—call it Ego—or a mere limitation, a lack of versatility; so that these new things must be clothed in the fashion of the old.

My words grow futile? I can only say then that this first encountered being seemed like a girl, wistful of face; grey, colorless of aspect; yet solid—as solid as ourselves which every moment was seeming a more normal solidity. But what to a mind Omniscient she would have been, again I do not know.

Will touched her. "Rob—Bee—this is Ahla—she has been waiting for us."

Her voice said, "I am Ahla who will do what I can to help you."

The tone seemed soft, liquid, musical and wholly feminine. Soundless words but clearly intoned as though I had heard them with a physical ear.

Bee said, "Why she speaks English."

It struck a note of whimsicality; the thought momentarily relieved the tension under which I was laboring. And so I think it was with the others; they were smiling; but Will's smile faded as he turned to us.

"You must keep on thinking things like that. Cling always to normality." His voice was earnest. "You also, Ahla—English you see, is our language."

"But you are speaking my language," she said gravely.

"Of course," he agreed hurriedly. "Do not doubt it. All of you—I think I understand best of us all. We must strive for our accustomed normality. Remember — the mind now is nearly everything."

"I am—not really confused," I said.

It relieved him; he spoke more quietly. "This girl, Ahla, came from her own realm—wandered out here to see and feel for herself what madness was possessing her people."

"It is strange," Ahla said abruptly. "I am frightened—" Sudden terror marked her features. I was standing nearest to her and her hand gripped me. Again I felt that blessed solidity. Normality. I was real; I laughed contemptuously at all these shadows. The girl added anxiously.

"Cannot we go back? Now—where all is real—not like this. I—cannot stay here much longer."

"We will go," said Will. "Bee—and you Rob—listen carefully. From now on it is a question of the power of our minds—our will-power. If you wander—weaken for a moment—we are lost. Keep thinking, I am here with my friends. We are going together—going into the other realm." He swung to the girl. "You, Ahla—for you it is easier. But yield yourself slowly. If you withdraw resistance you will rush beyond us. You understand? Above everything else we must keep together."

She nodded. "Oh—yes, we must keep together."

We clung to each other. Ahla began moving forward, drawing us onward up that empty Borderland slope which now was steeply inclined. We passed through the haystack—a mere shadow; passed upward through a corner of the barn roof.

Beneath us now spread the phantom world we had left. But as my thoughts dwelt on what we were going to do, the shadows of our earthly realm seemed fading; growing dimmer, blurring as though about to vanish.

I watched them fearfully; when they were gone I would be in darkness—pregnant darkness thronged with things unseeable. I thought vehemently.

"We must keep together—we are going on into that other realm, Will says we are—Will says we must keep together."

But my thoughts strayed, I remembered Will's house; the room we had left—the little clock— Why, I fancied I almost saw it. Was I there, back in that room? — Where was Bee?— Bee?—

I must have called her name in my thoughts, and at once she answered.

"Here Rob. Right here." And I felt the pressure of her hand.

A struggle of the mind. I knew then that every quality of mind inherent to me was winging backward; tugging, pulling, but I fought against it. And I became aware too of a different struggle within me. I had sensed it for some time past but now it sprang into keen intensity. A struggle of the physical. A vague racking pain possessed me. Dull, detached seemingly from my consciousness, yet I knew it was the pain of my body. It grew sharper. Not intolerable; but frightening with a sense of horror. It permeated my every fiber; tingling with infinitely tiny needles; and tugging, physically as my mind was tugging, to resume its original state. Like a chip in an undertow I was being drawn backward . . .

"Now." I felt Will's tense voice. And Ahla's soft words.

"We—are—passed. Hold me—now."

Someone was clutching my arm. I seemed floating, storm-tossed—a feather blown in a wind I could not feel. But abruptly the struggle ceased; vaguely I was conscious that my feet were standing upon something solid—Will and Bee were here—Ahla was here—I was a reality once more, and there were rational thoughts to think and real things to see.

CHAPTER VIII

THE REALM OF NEW DIMENSIONS

THE shadows of our world were vanished. The Borderland, with its darkness, its drab empty slope, was gone. A new world lay spread about me; new companions. And I was conscious of a new entity—a new Robert Manse, who was myself.

I remember now that my first thought was surprise that I should be able to visualize things of strangeness. But now I know that once over the Borderland my *mind* itself had changed, yet retaining of its old self just enough, so that I might be conscious of the strangeness. In a grey half-light of luminosity seemingly inherent to everything, I found myself standing upon a hillside, gazing down an empty slope of greyness. Was it land? I can only say that it seemed solid beneath me; solid, quivering with a tiny tremble; vibrating, and within itself vaguely luminous.

Overhead was darkness. Yet hardly that, for the same luminosity was there; and I felt that I was gazing, not through emptiness but rather through some tenuous fluid illimitable to my vision, with things there to see, as yet—for me—unseeable.

The slope before me was empty. But shapes were materializing; it was as though I had come out of the darkness, with eyes not yet accustomed to the light. I fancied I saw water in the distance. A white lake; but when I stared, it seemed more like a grey rolling cloud. Was it liquid?

The mind receives a multitude of impressions in an instant. I was conscious of myself. My body was an entity wholly vague—yet there seemed a tingling in it; a *weight* to it, for I was standing upright. Will and Bee—and the girl Ahla—were beside me. I saw them now in their old familiar form, but with a queer sense of *flatness* to them. Flat; unnatural of outline; not grotesque, merely strange, unreal. Almost indescribable; and though distinctly it was not a two-dimensional aspect, I think that *flatness* best describes it. A something about them which was lacking; or perhaps a something added—I do not know.

And inherent to this whole realm as soon I was to see it, was this same queer flatness. Things without *depth;* yet to view them sidewise, the depth was there, with the flatness still persisting.

And I saw color; nameless colors which I might call blue, or red, or green and the words would have no meaning. Men, women—houses, or at least habitations; the words are all I can command, but they are grotesquely meaningless. It was all so incomparably strange; and paradoxically, the strangest of it all was the fashion in which my mind began to accept it. I could think of Ahla as nothing but a girl. A frightened, likable girl—with thoughts and feelings similar to my own. This realm was real—a new country; with friends, enemies—a struggle going on within it in

(*Continued on page* 734)

Synopsis

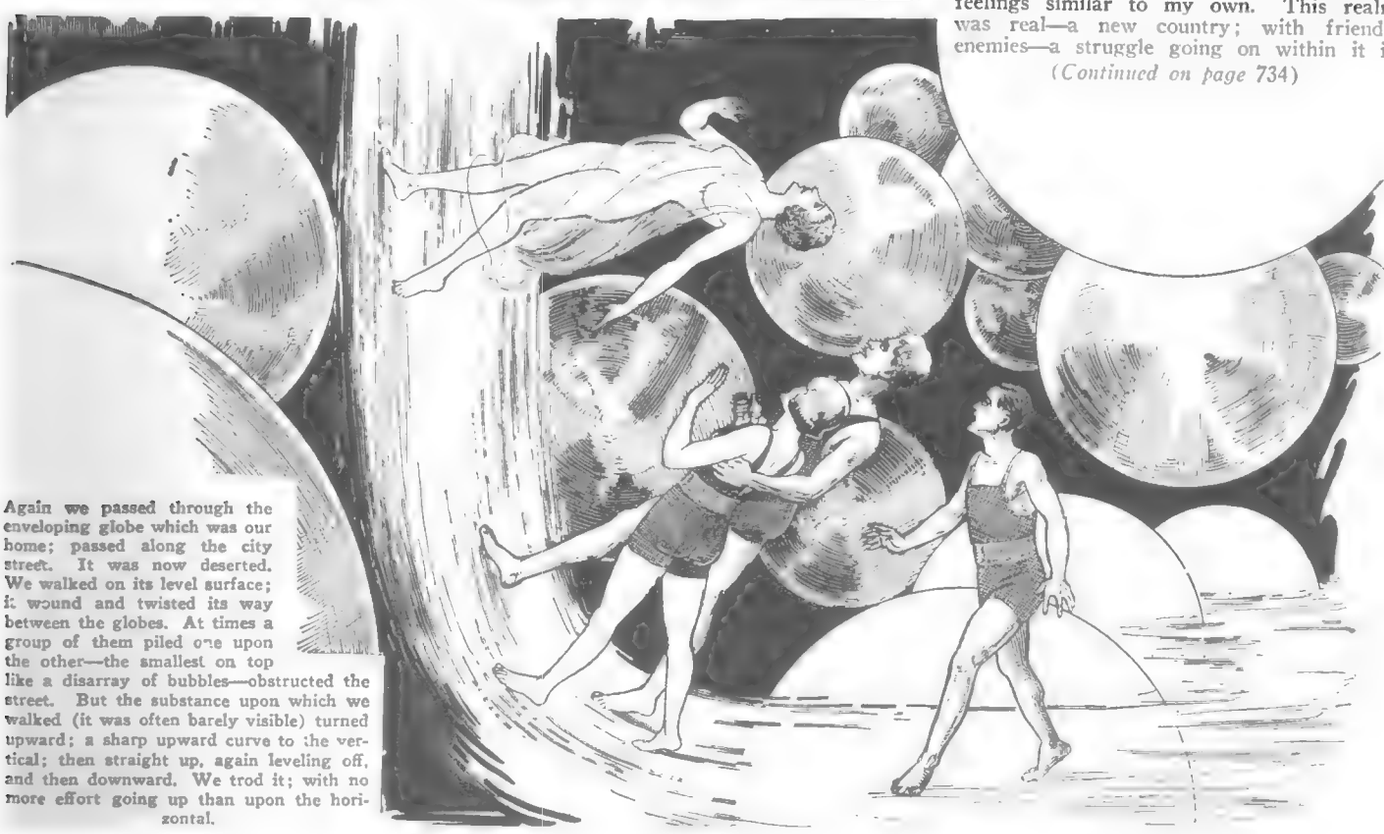
Robert Manse, a correspondent in the New York Office of a Latin-American export house, in company with Wilton Grant and his sister Beatrice, saw the first of the ghosts in February, 1946, *a few miles from Rutland, Vermont. These ghosts were semi-transparent, glowing figures much resembling human beings. Attempts to destroy them with bullets or clubs had no effect on the shadows. Passing the hand through the space occupied by one of these ghosts produced no tangible sensation. Later, the ghosts became more bold and more numerous, even molesting human beings and causing at least one death in Kansas, the result of heart failure induced by the fright of encounter.*

Some time later, Will calls Rob on the telephone, saying that his sister Bee is quite ill and asking Will to pay them a visit. During the visit Will mentions that the ghosts have already arrived in the Borderland lying between their world and ours, and that they were on the point of coming into our world. Rob himself has discovered a means of entering into this borderland, and declares that even though he is being watched by many of the ghosts he will make an attempt to-night to enter their realm and turn the spirit-like creatures back into their former paths. While he makes the journey, Rob is to stay behind with Will's sister, Beatrice.

The preparations for the experiment are made, and Will clasps upon his arm a connection to the vibration-transformer which, by altering the vibrations of his body, is to transform it from normal substance to the wraith-like material of the other world. They see a ghostly form watching them as Will's body becomes transparent, but finally the apparatus is disconnected and they wait for his return. Five hours later, Will returns saying that they must go back with him to save the world from an invasion of the ghostly hordes.

Robert and Beatrice, though face-to-face with the unknown, succeed in suppressing their fear, and agree to accompany Will across the border. The three adventurers don their metallic garments, attach the batteries, and swallow the acrid compound which is to transform their tissues. In a few minutes they find themselves transposed into the Borderland, and they alertly wait for what may come.

Now continue with the story.



Again we passed through the enveloping globe which was our home; passed along the city street. It was now deserted. We walked on its level surface; it wound and twisted its way between the globes. At times a group of them piled one upon the other—the smallest on top like a disarray of bubbles—obstructed the street. But the substance upon which we walked (it was often barely visible) turned upward; a sharp upward curve to the vertical; then straight up, again leveling off, and then downward. We trod it; with no more effort going up than upon the horizontal.

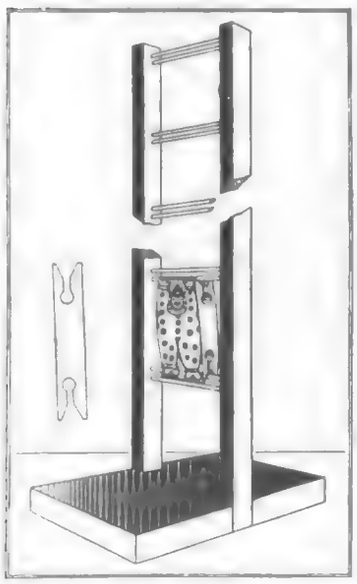
Santa Goes in

Christmas Gifts From a

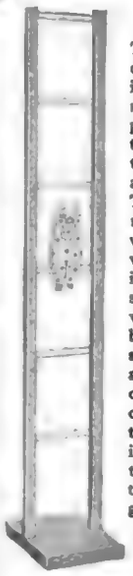
FLOATING DICE

The above photograph shows a cylindrical celluloid container filled with water and holding two dice which float to the surface when the container is inverted. The system is fraud-proof and ideal for operating toy games.—Hydro Novelty Co.

TUMBLING CLOWN



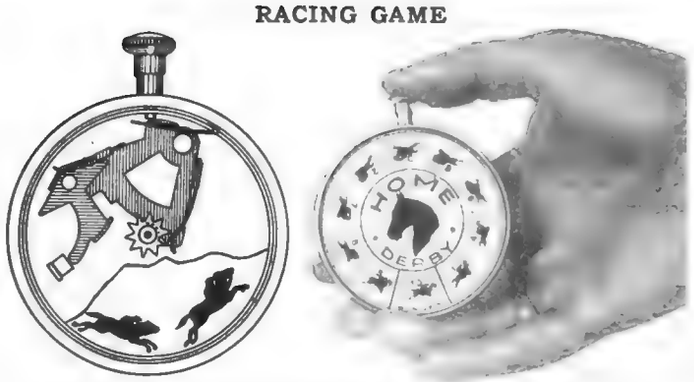
The above diagram in the accompanying photograph shows a very interesting clown. The wooden clown tumbles from rung to rung of the ladder until he reaches the bottom. It will be observed that there are two uprights secured to a base and that the rungs of the ladder are made of double bars of heavy wire. Due to the peculiar construction of the slots in the hands and feet of the clown, it is apparent that the wood figure will drop to the rung below and then turn on the rung through an arc of 180 degrees until ready to drop to the next rung.—Miami Wood Specialty Co.



The photograph and diagram at the right illustrates a unique racing game in which pressure on the button at the top causes the horses to run around very rapidly. The game is approximately the size of a watch and is provided with a very interesting mechanism for spinning the disk, as well as quite a clever brake. When the stem is pressed down, a metal catch moves over to the right, grips one of the prongs of a ten toothed gear, and imparts momentum to the gear. This causes the dial to which the gear is connected to spin.

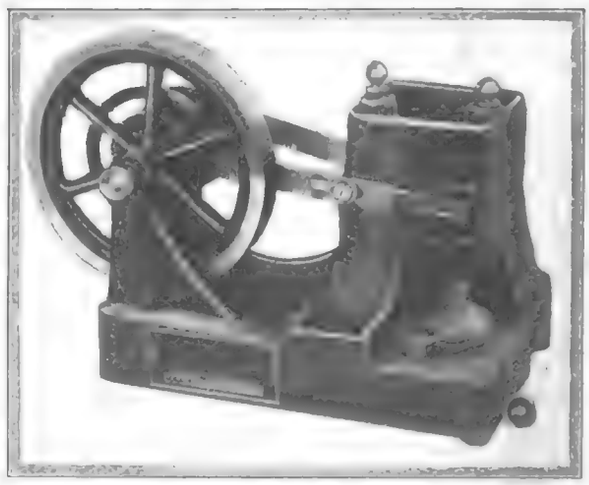
Quack medical men sensing the possibilities of fooling the public by using radio apparatus in ridiculous combinations and hook-ups, are selling all sorts of machines for home medical treatments. See the January issue for an expose of some of these devices.

RACING GAME



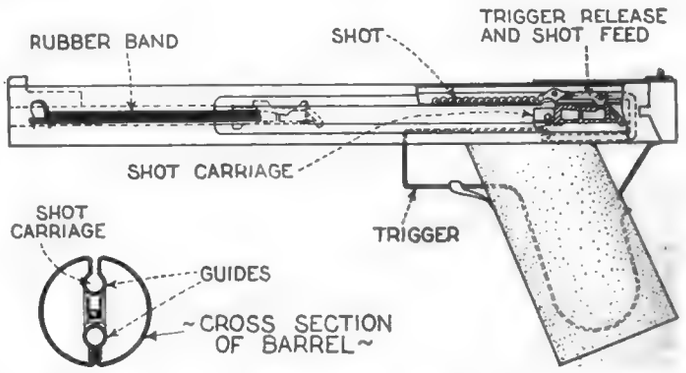
If the stem of the game above described is released the brake moves toward the center stopping the race so that one of horses is always immediately above the winner designation.

A VACUUM ENGINE



The photograph above shows a very unique innovation in toy engine designs. This engine works by atmospheric pressure. It is not a hot air engine. The alcohol lamp is lit and the engine turned over a few times. It will be found that the flame is sucked into the chamber of the engine where it expands the gases. A slide shuts the port and the gases on cooling contract, the atmospheric pressure pushing the piston in and thus causing rotation.—Modern Engine and Supply Co.

SAFE ACCURATE MAGAZINE PISTOL



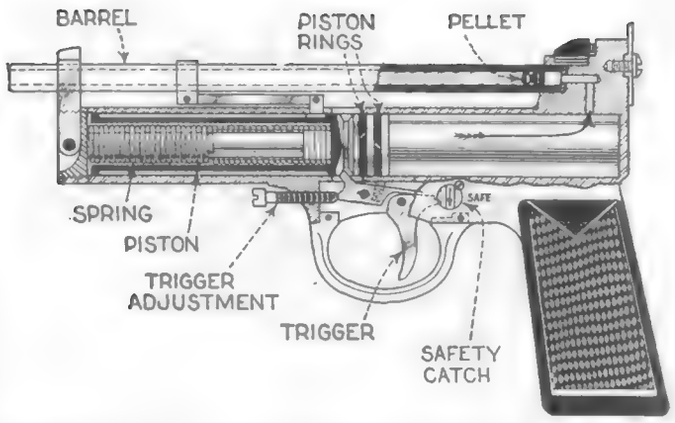
The photograph at the left shows a magazine pistol operated by rubber bands. The force of the shot can of course be varied by using two or more rubber bands to operate the shot expelling mechanism. The pistol is being held in the hand to show the comparative size. It will be observed from the drawing above that the top of the pistol provides a magazine for the shot. One of these shots is released each time that the shot carriage is pulled to the back end of the pistol. When the trigger is pulled, the entire carriage moves forward and the shot is catapulted out of the end. So remarkably accurate is this pistol that a trained shooter can place a shot on a piece of paper and hit it with a similar shot expelled by the gun. The shot carriage rides on two guides, the upper one of which also serves as the magazine.—Bulls Eye Pistol Co.

for Science

Scientific Standpoint

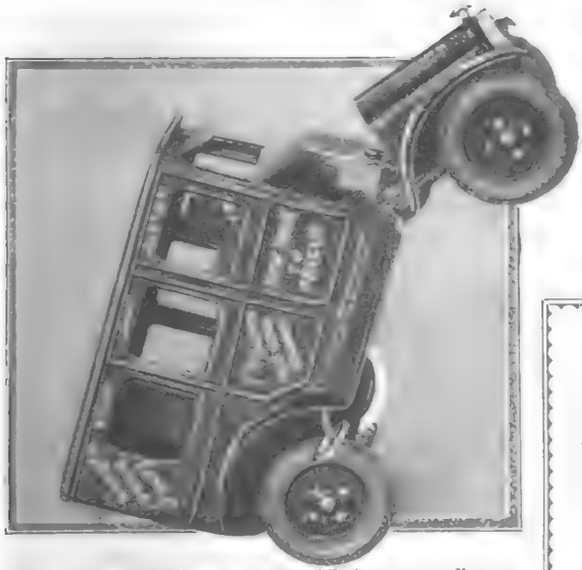
POWERFUL TARGET AIR PISTOL

The above photograph shows a remarkably powerful air pistol intended for target practice. Its weight is practically the same as an automatic and it balances in the hand in the same fashion. It is absolutely accurate at short ranges. The diagram of construction is shown at the right.



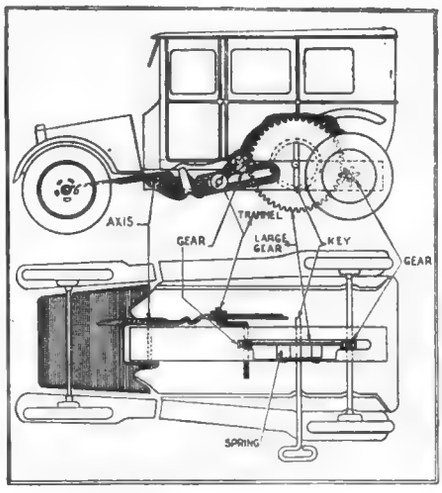
The above diagram shows the construction of the air pistol. Near the back end and immediately above the barrel a catch will be found which is pressed backward and the barrel is then raised to compress the spring. In the diagram the spring is shown in the compressed position. A .22 calibre pellet is then inserted in the barrel and the same locked in the position indicated. When the trigger is pressed, the spring is released and the air is transmitted into the barrel chamber. Notice the piston rings on the piston.—Wembley & Scott Arms Co.

DIZZY LIZZIE—A UNIQUE TOY



In the photograph above the automobile is seen standing on end. In this position the auto bucks like a typical bronco. This procedure continues until, because of a violence of one of the bucks, the equilibrium of the mechanism is upset and the auto falls down on all four wheels and proceeds to run away with its continued bucking movement.

The diagram at the right shows the mechanism for operating the toy illustrated in a photograph at the left. The entire body of this automobile is mounted on a carriage by two pins located at the front and back of the auto. A trammel directly connected to one of the gears communicating with the spring, causes the auto to bump up and down and this motion in turn imparts a sideways or rocking motion to the body of the car.—Ferdinand Strauss Corp.

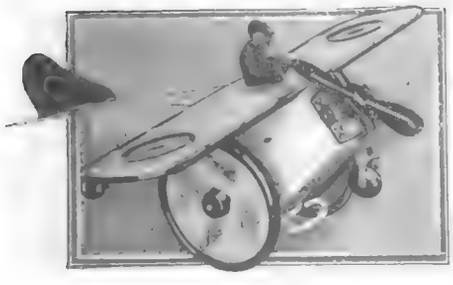


Due to lack of space the publishers were forced to omit the article on Muscle Reading with illustrations showing the incomparable "Dunninger" demonstrating this system. Look for the article in the January issue.

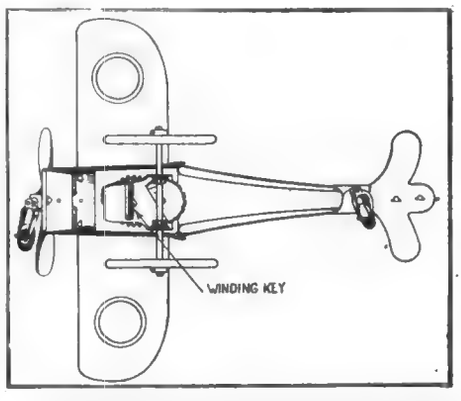
The articles on this page will make ideal Christmas gifts for men and boys. There is no doubt but that members of the fairer sex get quite a kick out of most of them. Perhaps the suggestions on these pages will aid someone in picking out an unusual gift.

A postal card of inquiry concerning the names and addresses of any of the manufacturers of devices found in SCIENCE AND INVENTION Magazine will bring the desired information.

TOY AIRPLANE

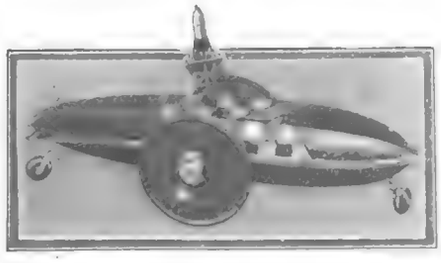


The photograph above shows the toy airplane which performs on the ground or floor in much the same manner as an expert aviator. It nose dives, tail spins and never repeats the same effect all because its designer foresaw the possibility of employing a fairly well balanced toy and equipping it with one wheel, which is free, and the other one which moves forward and backward alternately.



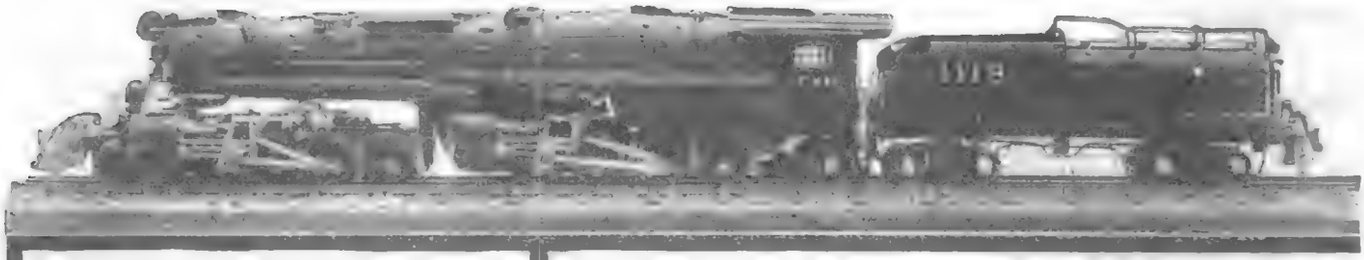
The above illustration shows the mechanism of the airplane, one wheel of the plane is free and the other is connected with the shaft and gears. —Ferdinand Strauss Corp.

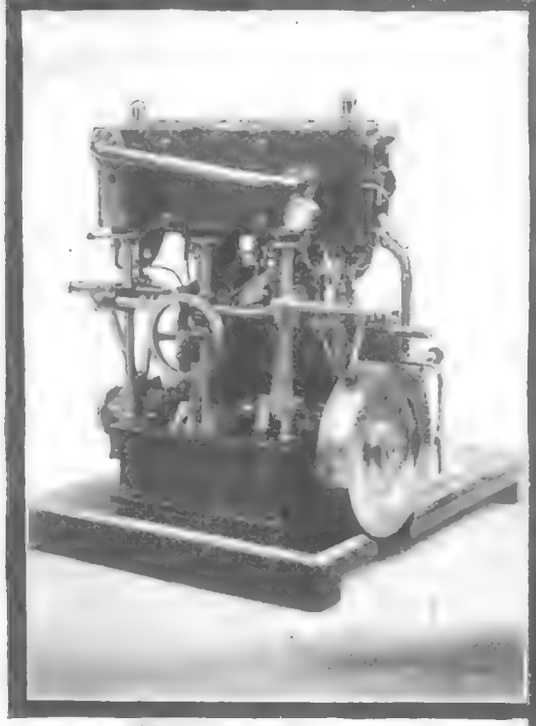
AN ODD TOY



The toy of peculiar shape illustrated in the photograph above is operated by a mechanism identical with that shown in the drawing of the airplane at the left. It will be observed that one of the wheels is lashed back and forward, while the other wheel remains free. The capers cut by the toy are never the same.

MODEL DEPARTMENT

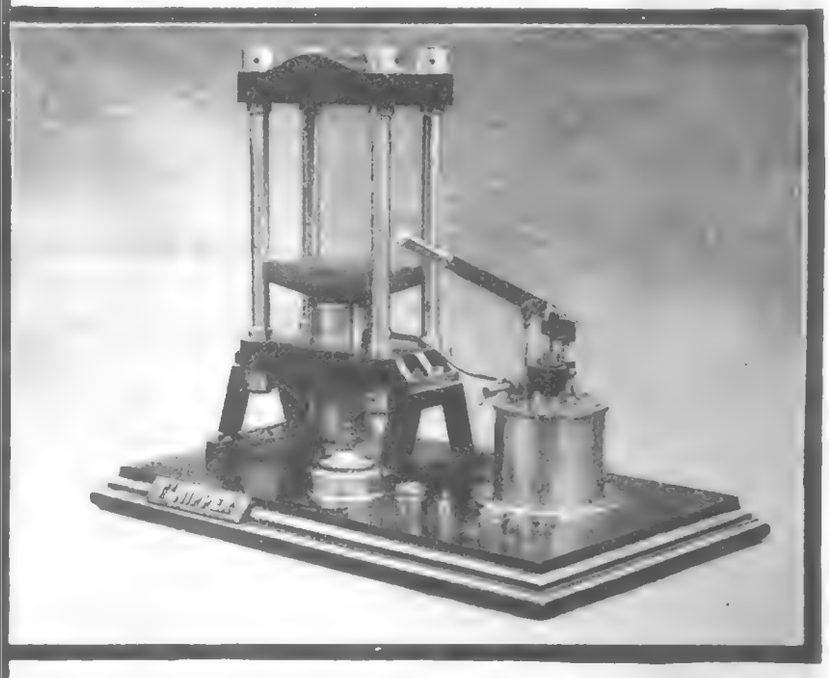




The photograph of the model above is that of a compound condensing steam engine built by G. T. Williams, and the one below is a model of a steam tractor constructed and exhibited by H. Smallbones. This particular model won a silver medal at the exhibition at Horticultural Hall, Westminster.

THE statement has often been made that our English cousins are far advanced in the art of building models over the American youth. Of course it is perfectly natural for the American lad to dispute this fact and state that he has seen as fine models built in this country as any of foreign make. The fact of the matter is that the art of model building is much more popular in England than in America just as radio in America is much more popular than model making. The American boy has not yet arisen to the point of seeing the possibilities which model engineering holds in store for him. On this page we are showing a group of photographs of models from an engineering exhibit in England. We do not doubt but that the constructions are very remarkable and we also wish to advise those of our readers in foreign countries that the SCIENCE AND INVENTION Magazine trophy contest is open to them as well as to those in America. Every month this publication offers a handsome trophy cup for the best model submitted during any one fiscal month. The conditions of the cup contest will be found on page 746 of this issue.

The photograph immediately above is a 7 mm. scale model of a 2-8-8-2 compound locomotive, a duplicate of the Chesapeake and Ohio Railroad. The model is electrically driven, and was built by Mr. A. Knock.



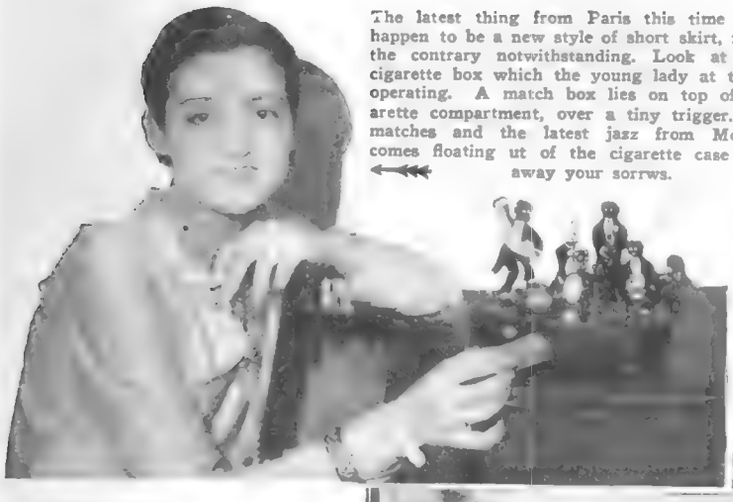
The model above was made by F. C. Hill and represents a hydraulic press.

At the right is illustrated the handsome trophy awarded monthly by SCIENCE AND INVENTION Magazine for the best model entered during any fiscal month. The conditions of the model contest will be found on page 746 of this issue. One of these cups is awarded every month, so the model engineers of this country, and also of foreign countries will not have very great difficulty in carrying off an award. This cup stands nearly 18 inches high. On the front there is a shield representing model engineering. In addition to the cup, a certificate award of merit is awarded to the model engineer winning the trophy. Anyone can enter this contest.

America at the present time is busy building model ships. Many of these do not compare with foreign models. Most of the fine details are slid over and no effort is made to make the model look like the original. Even most of our engineering replicas are carelessly constructed. Here's hoping that some of our model engineering societies will wake up and that others will be formed to encourage the interesting pastime.

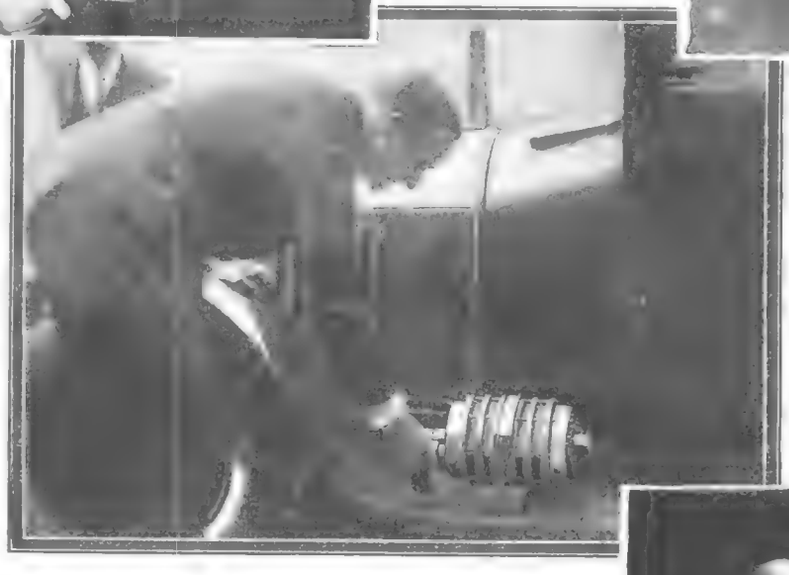
RULES FOR MODEL CONTEST APPEAR ON PAGE 746.

Science Moves On



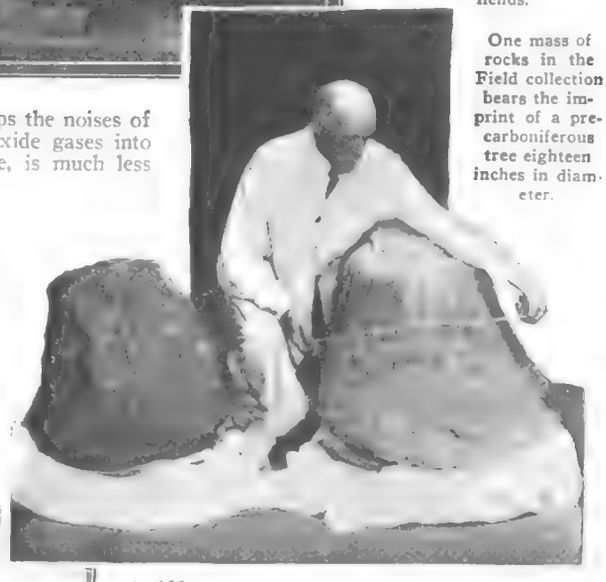
The latest thing from Paris this time does not happen to be a new style of short skirt, reports to the contrary notwithstanding. Look at the new cigarette box which the young lady at the left is operating. A match box lies on top of the cigarette compartment, over a tiny trigger. Lift the matches and the latest jazz from Montmartre, comes floating ut of the cigarette case to chase away your sorrws.

Col. B. C. Goss has developed the latest in protective devices for the flapper in this miniature gas pistol.



No more trembling moments for unescorted women now that milady has this sort of moral support. With the males completely at the mercy of her charms and her fountain-pen gas pistol, she need have no fear. The device was originally developed to aid policemen in case of attack by thugs, and it contains enough powerful gas to knock a man completely out for thirty minutes. Something tells us that this is the ideal instrument for poison-pen letter fiends.

SCIENTISTS at the Paris Laboratory of Toxicology have been working for some time on the problem of rendering the exhaust gases of automobiles less dangerous. Due to the high percentage of carbon monoxide present in exhaust-polluted air, the danger to pedestrians becomes more serious each day, as the number of automobiles in the large cities increases. The newspapers almost daily print stories of prostrations and deaths due to the inhalation of these gases, usually because the doors of garages are left closed, while the engine of a car inside is turning out carbon monoxide at full blast. After considering the possibilities of minimizing this peril, M. Eugene Royer developed the new type of muffler which is illustrated in the photo at the right. It is so arranged inside that it effectively damps the noises of the motor exhaust, and at the same time chemically converts the carbon monoxide gases into carbon dioxide or carbonic acid gas. This gas, while it will not support life, is much less toxic than carbon monoxide, and is at all times present in normal air.



One mass of rocks in the Field collection bears the imprint of a pre-carboniferous tree eighteen inches in diameter.

A valuable collection of fossilized trees, ferns and rootlets that flourished one hundred million years ago was uncovered in the construction of a dam at Gilboa, N. Y., and forwarded to the Field Museum at Chicago. At the right is a fossil tree stump.

A demonstration was recently given at Cricklewood before a group of aviation experts of the Handley Page-Napier deck-landing torpedo plane. This plane, which the makers claim will fly backwards, is fitted with a slotted wing which opens and shuts like a Venetian blind, enabling the machine to hover and alight or get off at low speed in a restricted area. Mr. Handley Page and Capt. A. F. Wilkinson, pilot, are shown above.

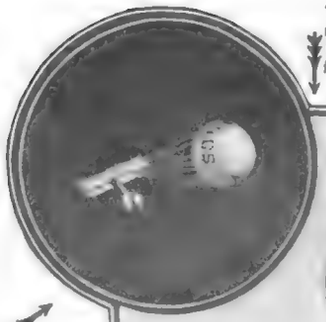
Amherst, Massachusetts, was the scene of a recent test with the portable dynamometer laboratory.

THE unit of work known as the "horse-power" was originally developed by actually testing the pulling power of a number of London dray horses and finding their average strength, but the unit has since applied exclusively to mechanical sources of power. It is of considerable interest to learn that through the efforts of Prof. E. V. Colins of the Iowa State College of Agriculture, we are about to learn just how much horsepower a horse develops. Prof. Colins has been experimenting with the dynamometer system of power measurement, and he has finally evolved a portable testing laboratory which he used at Amherst, Mass., to test the pulling power of horses and oxen. A light motor truck chassis is used as a mounting for the apparatus.

Aviation News

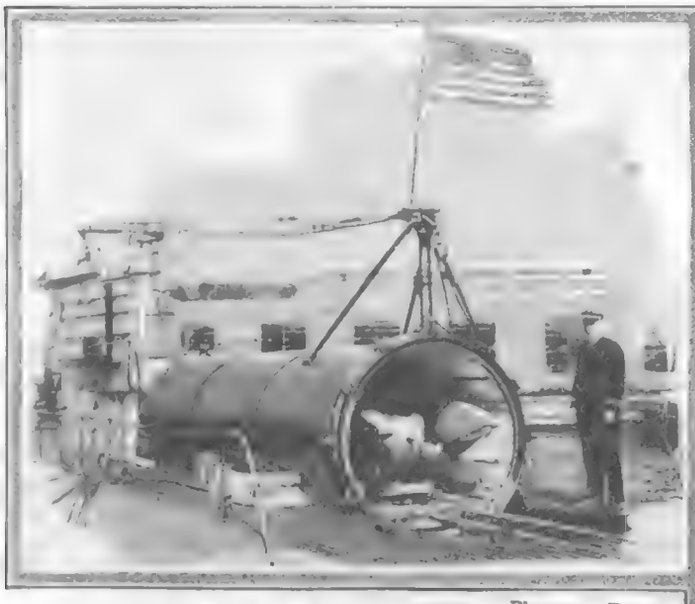
U. S. Submarine Carries Peanut Plane

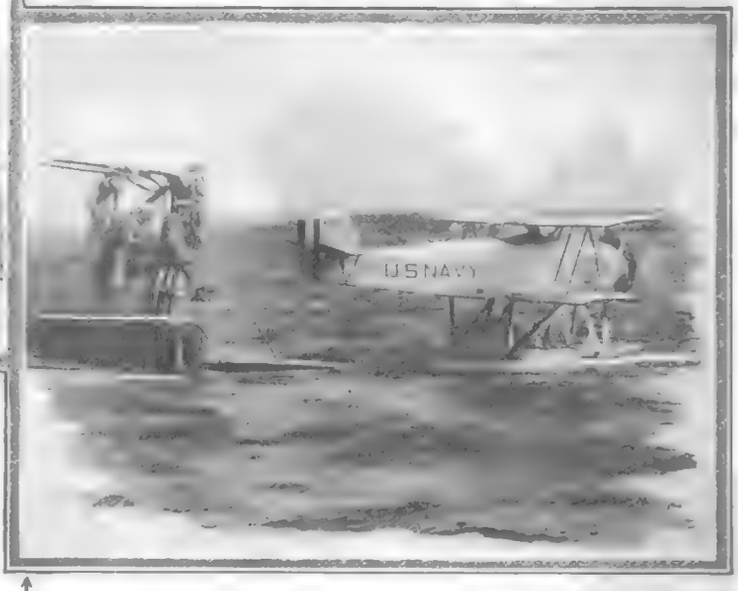
THE new submarine S-1 carries a small "peanut plane" in a cylinder on its deck. The plane weighs 1000 pounds and has a three cylinder motor. In tests conducted at New London, Conn., it was found that the plane could be taken out and assembled, ready to fly, in nine minutes. It is flown by the first submarine airplane pilot in the world, Lieut. Adolph C. Allen.

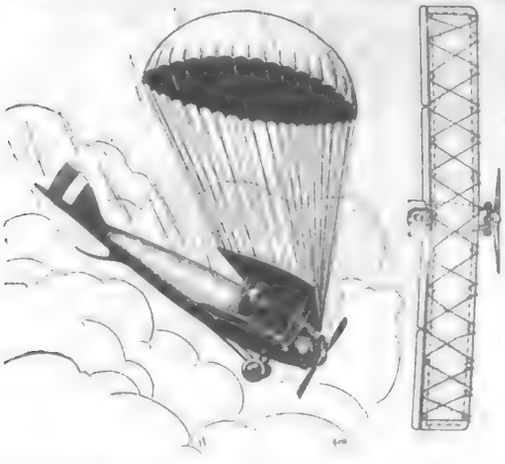


The movies added another chapter to science when the Paramount feature picture "Wings" made it necessary to perfect a new parachute for lowering plane.

The new parachute permits an 1800-pound plane to be lowered in perfect safety from 2500 feet.







Florence Doty, one of America's few women aviators, invented the parachute illustrated at the left. When not in use, the parachute is folded and lashed tightly to the top of the upper wing. Aviation experts approve it.

Here is the way the "Peanut Plane" looks when it is assembled and ready to fly. It is launched by partially submerging the submarine.

© Herbert Photos Inc.

THE two photographs, above and at left, show an ingenious device used by a large commercial aircraft company as a means of communicating with their pilots while in the air. The design at the left is a gale warning, and it is erased by simply folding back the hinged flap. As in the photo above, varying patterns of dots, each carrying a different meaning, may be formed very quickly by folding back the covers which hide them. In the background may be seen one of the concrete pylons, illuminated from above by high-power lights at night.

$5,000.00 Matchcraft Contest Awards

This ship is 23 inches long, 8½ inches high and contains about 10,000 matches.

MATCHCRAFTERS note—many of you will be unable to complete your models before December 1st, when the Matchcraft Contest officially expires. But don't worry about this. The contest will continue until further notice in accordance with a new list of prizes indicated on this page.

This model resembles the unsinkable ship illustrated in SCIENCE & INVENTION Magazine, the rigging is of cotton, the stern unclasps to show construction.

This photo shows Miss Sadie Bernstein holding the prize winning model in this month's contest.

FIRST PRIZE, $100.00, is awarded in this month's matchcraft contest to Walter J. Atkins, of Sault-Ste. Marie, Ont., Canada, for his model of a ship illustrated in the photographs above. In the upper left-hand corner the point of a pencil is pointing to a stairway constructed on this model.

16 Monthly Prizes

First Prize	$100.00
Second Prize	75.00
Third Prize	50.00
Fourth Prize	35.00
Fifth Prize	25.00
Sixth Prize	20.00
Seventh Prize	15.00
Eighth Prize	12.50
9th to 16th Prizes of $10.00 each	80.00

$5,000.00 Prize "Matchcraft" Contest

THIS CONTEST EXPIRES DECEMBER 1, 1926 AND A NEW ONE STARTS.

FOR the present year, SCIENCE AND INVENTION magazine will award a total of $5,000 in prizes, in a new contest. You are asked to make models, fashioning the same entirely from safety matches. Please observe the following simple rules:

(1) Models submitted must contain at least 90 per cent. safety matches in their construction.

(2) Models made of toothpicks, paper matches, or non-safety matches, are not eligible in this contest.

(3) Models can not be built around boxes or other supporting articles. Walls, roofs, etc., must all be self-supporting and made of matches.

(4) All liquid adhesives, such as glue, shellac, cements, etc., are permissible.

(5) Models may be painted, gilded or silvered.

(6) Models may be of any size.

(7) In order to win a prize, it is necessary that either models be submitted, or, if this is not practical, owing to their size, a 5"x7" photograph of the model may be sent in lieu of the model itself. The best models submitted each month will be awarded the prizes scheduled herewith.

(8) All models submitted to SCIENCE AND INVENTION Magazine will be promptly returned to the builder, who will prepay all charges.

(9) Where SCIENCE AND INVENTION has any doubts as to the model (where photos only are submitted) complying with all the regulations, the judges may, at their discretion, request that the actual model be sent in for inspection, paying transportation charges both ways.

(10) This is a monthly contest, lasting for twelve months, each monthly contest closing on the first of the month following date of issue. Thus the contest for the month of December will close January 1, 1927, and prize winning announcements will be made in the March, 1927, issue. The January issue will contain October prize winning entries.

Note that beginning with December, 1st, 1926, $100 in prizes will be paid monthly.

(11) Models must be shipped in a strong wooden box, never in a cardboard box, as SCIENCE AND INVENTION can not be held responsible for breakage in transit due to models having been improperly packed.

(12) When models are sent, be sure to affix tag, giving your name and address, to the model itself. In addition, put name and address on outside wrapper of package.

(13) Address all letters, packages, etc., to Editor, "Matchcraft" Contest, care SCIENCE AND INVENTION Magazine, 53 Park Place, New York.

IMPORTANT

ON December 1st, 1926, the $5,000.00 Matchcraft Contest officially expires. Any entries arriving after that date will be entered in a $100.00 monthly Matchcraft Prize Contest which will continue until further notice offering the following prizes:

First Prize	$50.00
Second Prize	20.00
Third Prize	15.00
Fourth Prize	10.00
Fifth Prize	5.00
Total	$100.00

Caution—Soak or cut heads from matches before building your model so that the models may be expressed or mailed. The strike-everywhere square cut Liberty matches can be used if the heads are cut off.

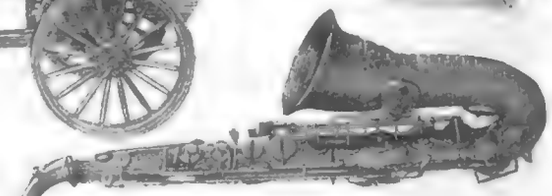
This contest started Dec. 1, 1925, and will terminate Dec. 1, 1926.

Matchcraft Awards *(Continued)*

Milk Wagon Wins
Second Prize - $75.00
Ladder Truck
Third Prize - - $50.00
Saxophone
Fourth Prize - $35.00

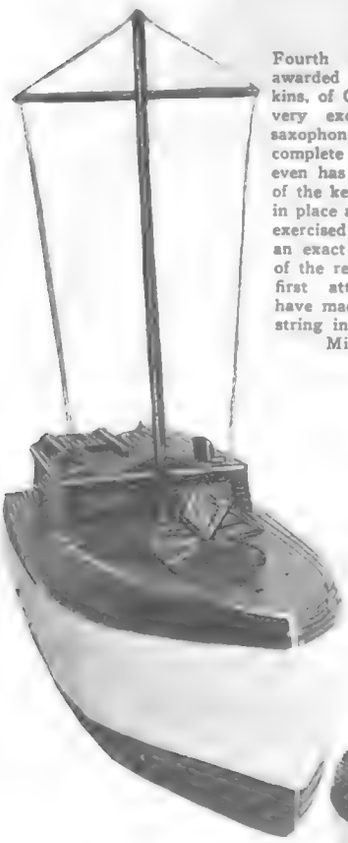
Third Prize — $50.00. is awarded in this month's contest to Carl Fichtner of Phila., Pa., for his model of a ladder truck illustrated in the photo below. Mr. Fichtner built two other ladder trucks, each of which arrived in a broken condition, before he finally succeeded in making one strong enough to withstand shipping difficulties. The extent of ladder is 24 in. long and is operated by a windlass, the rear wheels and shafts disconnecting thru a match coupling.

Second Prize — $75.00 is issued this month to Fred Spinden, of Abingdon, Illinois, for the milk wagon illustrated above and in the photograph at the right, the model being examined by Miss Mae Quellman. The wheels of this wagon are bound with brass strips; the window opens, the door slides back and forth, and as will be observed, even match springs are found on the model. The construction is 19 in. long, including the shafts, and 8½ in. high. This is not Mr. Spinden's first prize winning model.

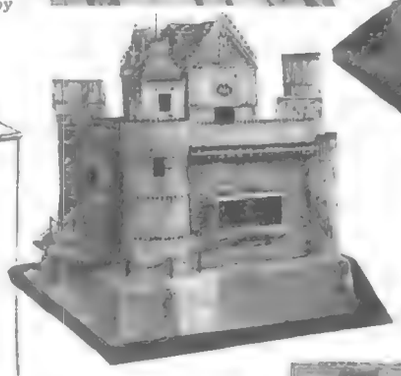


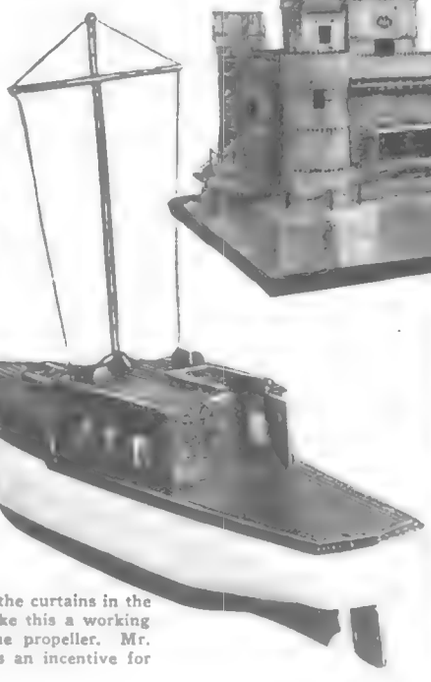
ALL matchcrafters should refer to the new schedule of prizes which will go into effect after December 1st, 1926. These are published on the preceding page.

Fifth Prize—$25.00 was won by Larry McCarty of Los Angeles, Calif., for his match construction of a castle. The two photographs below give two different views of this interesting bit of work. It will be noted that the draw bridge is down in both photos. The model measures 16 in. wide, 12 in. deep and 14 in. high over all. The base is constructed of plaster of Paris and marked to represent masonry.

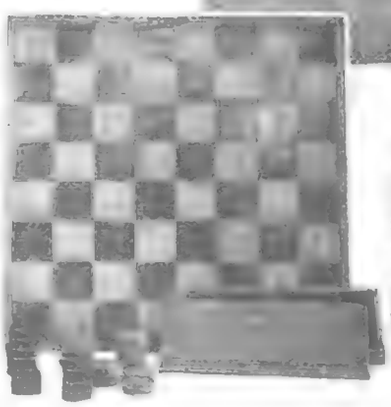


Fourth Prize — $35.00 is awarded to Ralph H. Hopkins, of Castle, N. Y., for his very excellent model of a saxophone. This saxophone is complete to every key and even has the rollers on some of the keys. The stops are all in place and extreme care was exercised in making the device an exact non-working replica of the real thing. This is the first attempt Matchcrafters have made to get away from string instruments. Posed by Miss Ruth Olsen.



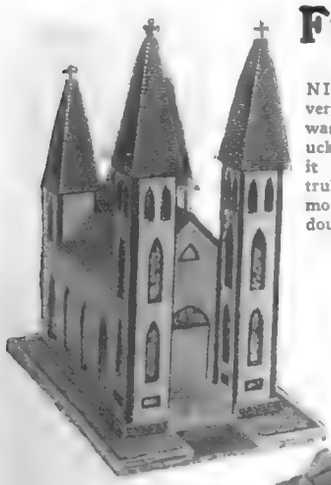


Sixth Prize—$20.00 was won by J. J. Quinn, of New York City, for his splendid example of a motor boat here shown. The boat itself is 21 in. long, and the deck is carefully ribbed, varnished and then shellacked. Note the curtains in the windows. The only thing required to make this a working model is to install a motor to drive the propeller. Mr. Quinn won a prize before which acted as an incentive for building another model.

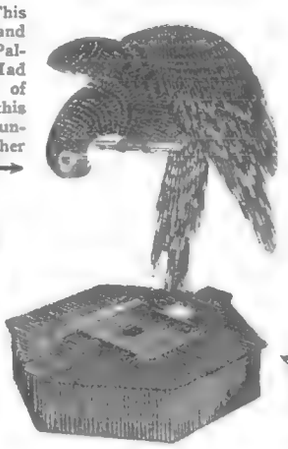


Seventh Prize—$15.00 is the amount awarded to Edward Raible, of Louisville, Ky., for the inlaid checkerboard, checkers and box here illustrated. Note that the matches for alternate squares of the checkerboard are stained to give the contrast between the squares.

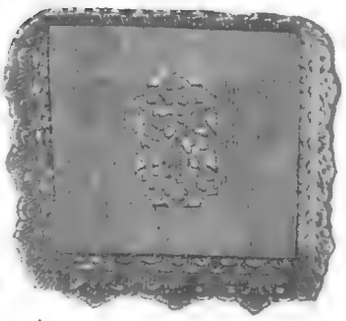
Further Matchcraft Awards



NINTH PRIZE—$10.00. This very wonderful parrot and stand was built by Alexander E. Paluck, of Belfield, N. Dak. Had it not been for the number of truly excellent models in this month's contest, this would undoubtedly have won a higher prize.



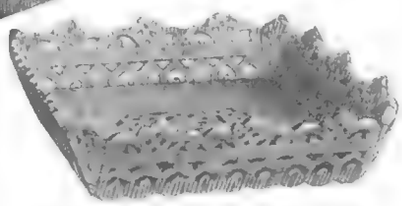
TENTH PRIZE - $10.00 was won by Herman W. Gerdts, of Brooklyn, N. Y., who in a previous contest won the first prize.



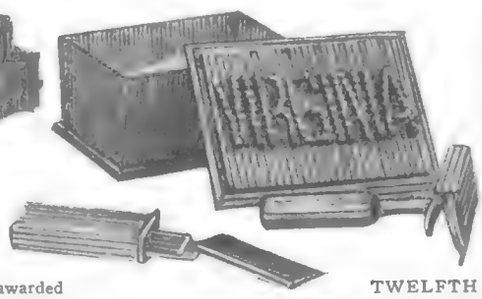
A top view of the card tray is illustrated in the photograph above. Note scroll saw pattern.

EIGHTH PRIZE — $12.50 is awarded to L. J. Schumacher of Bronx, N. Y., for the wonderful cathedral shown in the photograph above. It took a hundred and forty-five days to make this model. There are nine thousand match tips in the construction and twenty-one thousand pieces of matches. If all the matches which entered in the construction of this model were placed end to end, they would reach fifty stories higher than the Woolworth Building, and be twice the length of the S. S. Homeric. Nail polish rolled out and painted forms the windows.

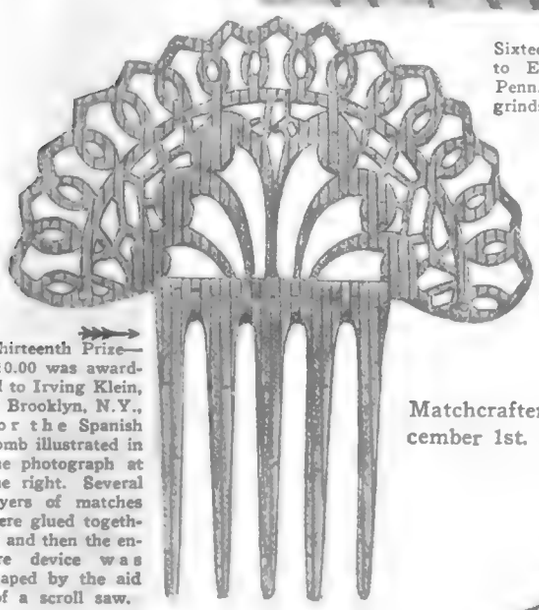
This photo shows Miss Ruth Olsen holding the ninth prize winning model. The model itself in knock-down form is shown above.



A perspective view of the card tray showing the pattern along the side is seen in the photograph above.

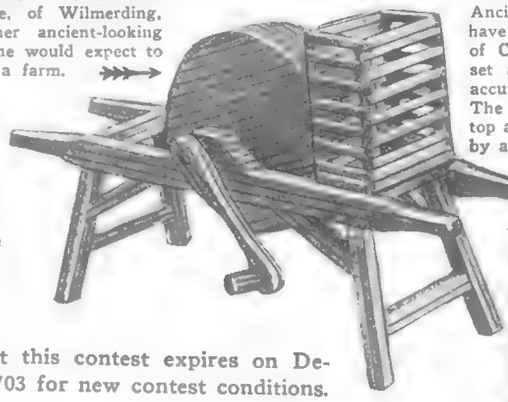


Eleventh Prize — $10.00 is awarded to Dr. A. A. Hansen of Virginia, Minn., for his model of a safety razor, razor blades, blade case and box. Would anyone believe that such things could possibly be made of matches?

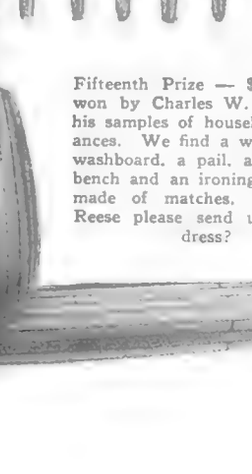


Sixteenth Prize—$10.00 was awarded to Edward Mazone, of Wilmerding, Penn., for a rather ancient-looking grindstone which one would expect to find on a farm.

Sandstones such as this are usually employed for grinding axes. Of course they cannot be made of matches.



TWELFTH PRIZE — $10.00. Ancient torture methods must have effected Mr. E. Don Bailey, of Columbus, Ind., because he set about constructing a very accurate replica of a guillotine. The knife may be raised to the top and is there hooked in place by a clamp controlled from the platform.



Thirteenth Prize—$10.00 was awarded to Irving Klein, of Brooklyn, N.Y., for the Spanish comb illustrated in the photograph at the right. Several layers of matches were glued together and then the entire device was shaped by the aid of a scroll saw.

Matchcrafters note that this contest expires on December 1st. See page 703 for new contest conditions.

Fifteenth Prize — $10.00 was won by Charles W. Reese for his samples of household appliances. We find a wash tub, a washboard, a pail, a broom, a bench and an ironing board all made of matches. Will Mr. Reese please send us his address?

Fourteenth Prize—$10.00 is awarded to William E. Lee of Richmond Hill, L. I., for the shapely pipe here illustrated.

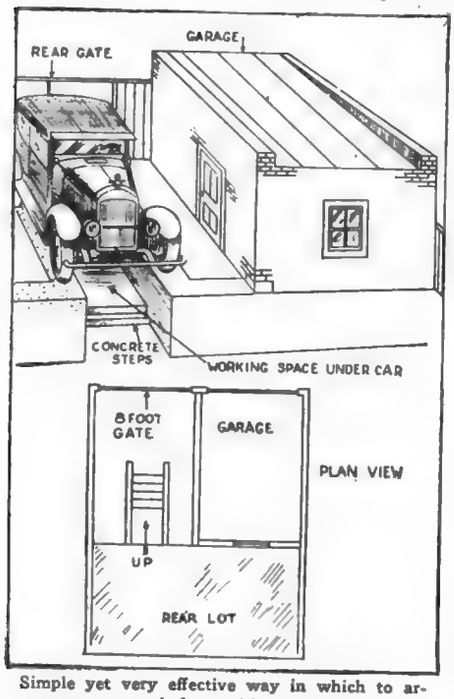
MOTOR HINTS

Conducted by GEORGE A. LUERS

A New Monthly Department Prepared by a Well-Known Automotive Engineer

PLANNING THE GARAGE LOCATION TO AID IN REPAIRS

A garage pit has little to recommend it and much to condemn it. It is usually a wet greasy hole to work in, the gasoline



Simple yet very effective way in which to arrange an open pit from which the bottom of an automobile engine becomes instantly accessible.

which collects there is bad on the health and monoxide gas, which is heavy, is more likely to settle in this pit.

It is possible to plan a garage on the rear lot, accessible from the alley which will provide facilities for maintenance of the repairs to the car. A brief outline of a planned garage on an eighteen foot or wider lot, is shown in the accompanying sketch.

The garage occupies one half or less of the lot, while the adjacent open space is provided with an eight foot gate made for entering the car. Service steps will be required from the rear of the lot to the alley, so these should be located in the center of the space, permitting the car to be driven into the space and over these steps. This makes it comfortable and convenient for the owner, to handle spring lubrication, brake adjustment, replenish the lubricant in the grease cups and attend the other details.

In the event the lot is level with the alley, then concrete runways can be used. These runways can be inclined so that the high ends are about three feet high and the intervening space is concreted.

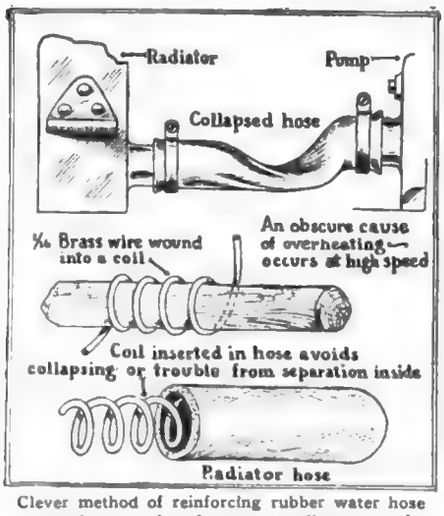
The car is driven in either backwards or forwards, permitting access to all parts and in fair weather the owner enjoys the advantage of working safely with plenty of light and ventilation.

HOSE CONNECTIONS MAY CAUSE OVERHEATING

If the car owner will change radiator hose connections each year, it is not probable that he will have trouble from this source. If on the other hand the hose connection becomes flabby and the inside rubber separates, as it will after a year or more of use, trouble will result.

The loose inner rubber will close an inlet or outlet passage, acting as a sort of check valve, with the result that a very obscure cause of overheating is evident in the engine. If the hose becomes flabby, it is quite often that the suction of the circulating pump will cause it to collapse and shut off the circulation of the cooling water.

To forestall trouble from hose connections, a commendable means is that shown in the attached sketch. This consists of coiling a piece of one sixteenth inch brass wire, over a brush or broom handle and inserting this in the hose before connecting it up. This is an assurance that the hose will stay extended and that the inside rubber will not obstruct the water passage. This expedient is readily adopted and the owner is saved from further trouble with the hose connections.


Radiator
Pump
Collapsed hose
1/16 Brass wire wound into a coil
An obscure cause of overheating occurs at high speed
Coil inserted in hose avoids collapsing or trouble from separation inside
Radiator hose

Clever method of reinforcing rubber water hose on engine, so that it cannot collapse as pictured above.

CAR FITTINGS VERSUS WINTER MUD

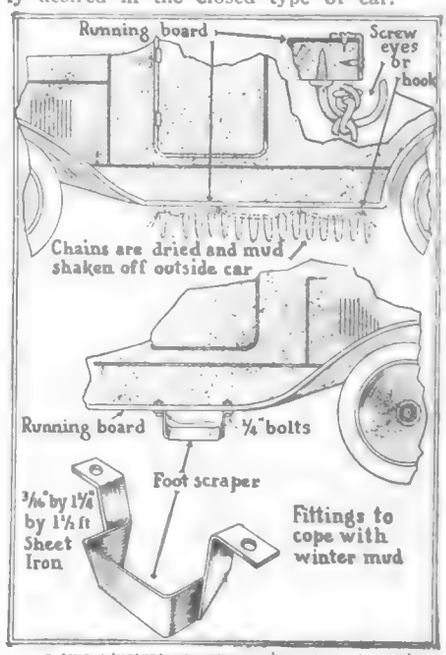
The driver will appreciate the advantage of the foot scraper shown in the attached sketch, especially the Ford driver who knows the difficulty of operating the foot pedals, when the frost has stirred up a sticky mud that causes the feet to slip.

This attachment can be made from a strip of iron, about a foot and a half in length, three sixteenths inch thick and one and a quarter inches wide. This is secured with a couple of quarter inch wagon bolts under the right running board at the driver's entrance.

The second fitting shown in the sketch, is a means for clearing tire chains of the mud and moisture, before stowing these chains under the rear deck or under the seat.

Four hook bolts are attached on the left running board, to which the chains are hooked on when these are first removed from the tires.

The movement of the car and the air will shake off the mud and dry them nicely, that they can be stored, without messing up the other tools with dirt and causing the chains to be rusted and hard to handle. These attachments contribute somewhat to keeping the inside of the car clean, which is especially desired in the closed type of car.

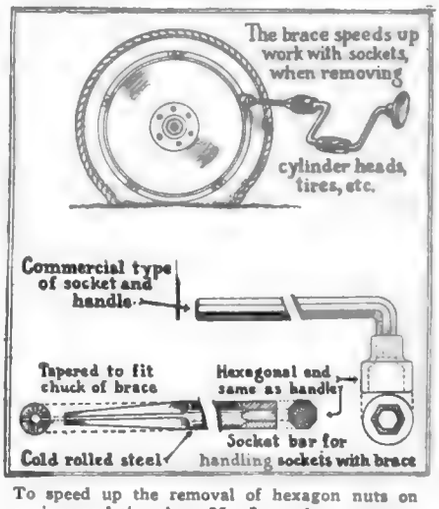

Running board
Screw eyes or hook
Chains are dried and mud shaken off outside car
Running board
¼" bolts
Foot scraper
3/16" by 1⅛ by 1½ ft Sheet Iron
Fittings to cope with winter mud

The two illustrations above show how to make a simple foot scraper useful in winter weather, and also how to dry and shake the mud from non-skid chains by suspending them along the running board.

BIT BRACE SPEEDS UP SOCKET WRENCH

There are sixteen cylinder-head bolts in the joint of a Ford engine, each of which requires time and patience to remove with the usual wrench equipment. Other engines have frequently more than this and require still more patience, when it becomes necessary to remove the cylinder head.

(*Continued on page* 741)

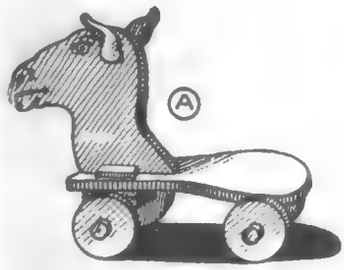

The brace speeds up work with sockets, when removing
cylinder heads, tires, etc.
Commercial type of socket and handle
Tapered to fit chuck of brace
Hexagonal end same as handle
Cold rolled steel
Socket bar for handling sockets with brace

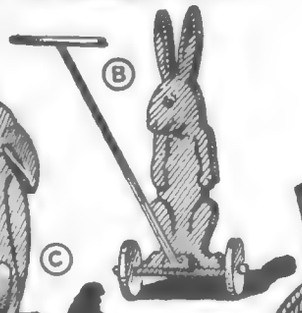
To speed up the removal of hexagon nuts on engines and tire rims, Mr. Luers here suggests the use of a carpenter's brace with the fittings described.

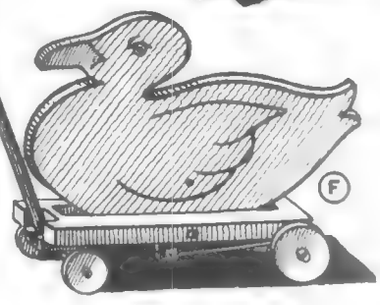
Home Mechanics

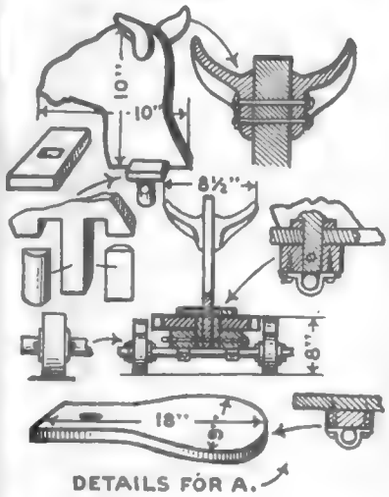
Home-Made Animal Toys

By W. M. BUTTERFIELD

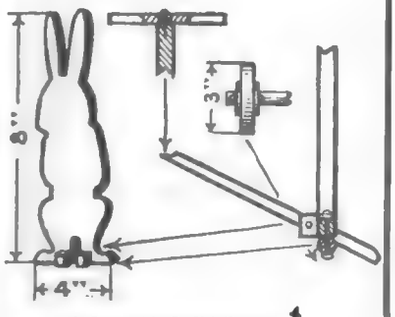




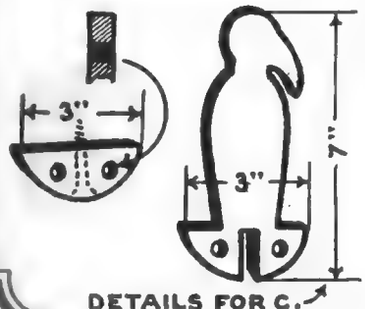




DETAILS FOR A.



DETAILS FOR B.



DETAILS FOR C.

PERHAPS one of the most popular things of the day is the animal toy. It would seem, from its popularity, to be the fascinating one to make. For this reason we have laid out a page illustrating six toys that may serve as suggestions to the home-mechanic. Native inventive propensities and caricaturing ability can increase the number indefinitely, for the styles now shown on the market are beyond number with very good possibility of others yet to come.

Not only is the making of the toy fascinating, but the artistic ingenuity involved in choosing colors and the "motif" of treatment is more than fascinating. The most successful treatment for painting is that of broad flat tints, where no attempt is made at blending the different colors employed. Enamel paint is used over a priming coat. The colors are white, black, brick red, lemon yellow, grass green and new blue.

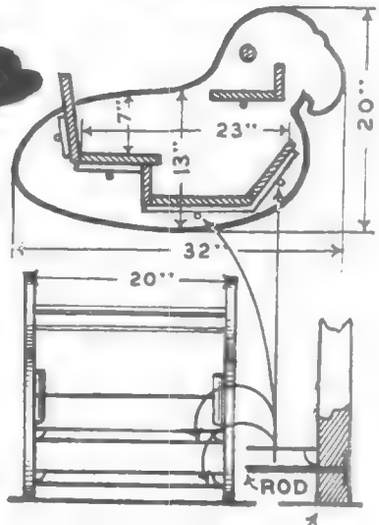
It would seem advisable before painting a toy to sketch out on paper rough outlines in contour, and color the sketches either with colored chalks or with water colors. Several attempts may be made in this way until a pleasing combination is obtained—comparison of the various sketches thus colored will aid in making a final choice.

Details, sections and dimensions are given for each example on the lower portion of the page.

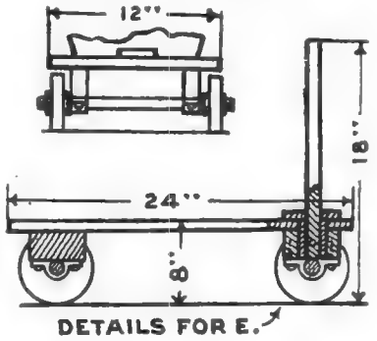
The first sketch (A) shows a kiddy car. The car is made of ⅝" and of ½" plywood lumber —⅝" for the wheels and seat and ½" for the head, which is that of a young goat or kid. The ears, serving as handle bars, are made of hard wood, as are also the brackets holding the wheel. The car may be painted with red seat and under-parts, yellow wheels, and head slate gray with nose, eyes and mouth outlined in black.

The next is (B) a rabbit toy. It is made of ⅜" plywood, has a metal shaft and hard wood handle. It is painted white with black eye, nose, mouth and other outlines for the rab-

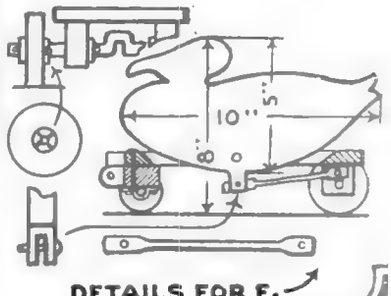
(*Continued on page 742*)



DETAILS FOR D.



DETAILS FOR E.



DETAILS FOR F.

Applying the Bunsen Burner

By J. M. BYERS

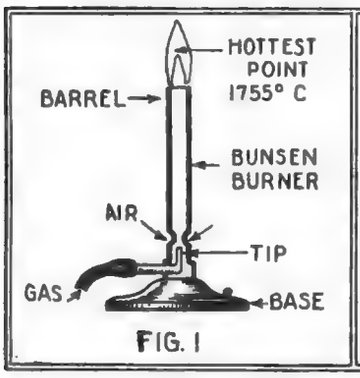


FIG. 1

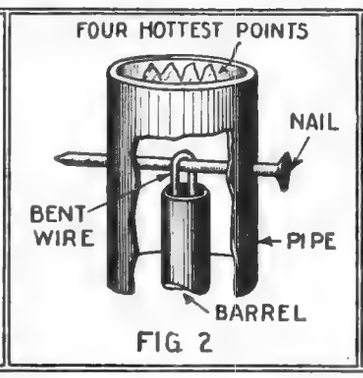


FIG. 2

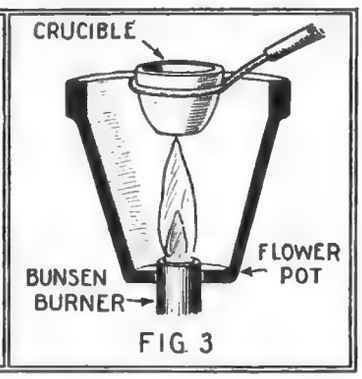


FIG. 3

The five illustrations give what may be called a sort of treatise on the Bunsen burner. Different ways of using it are shown, which are explained in the text on the illustrations, and these are only suggestions for the burner can be used in many other ways. Referring to Fig. 6, there is one thing to be remembered about the Bunsen burner, that if it does burn at the base, it gets very hot; it may melt the tube and light the gas and cause a conflagration.

1. The best known of laboratory heating apparatus is the Bunsen burner. This simple, yet ingenious contrivance is capable of reaching a temperature of 1755 degrees centigrade, the melting point of platinum and of rocks. You can prove that the Bunsen flame reaches this temperature by fusing a fine platinum wire in it. This high temperature is confined to an area so limited that for practical purposes 600 degrees is reached with difficulty.

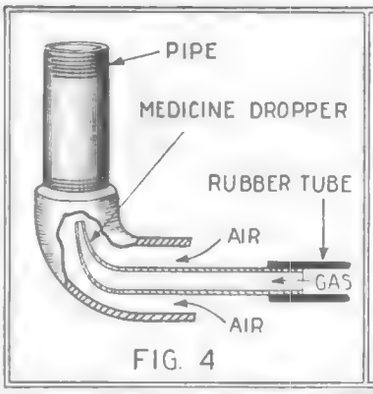


FIG. 4

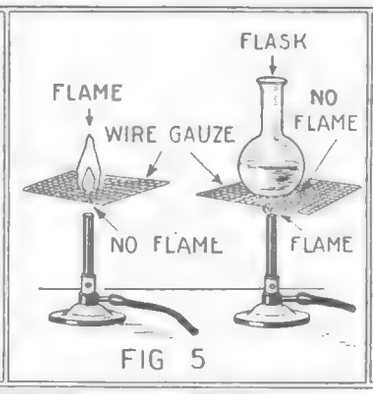
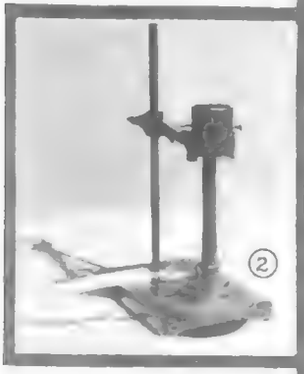


FIG 5

FIG 6

2. Several methods of obtaining more heat with the Bunsen burner are in use. One employs a device shown in the picture. This piece of apparatus constructed from a section of one-inch pipe, a nail and a bent wire, splits the flame in four parts giving four hottest points instead of one. The results are quite satisfactory for fusions and ignitions and ordinary laboratory use. Experiment will show you the height at which the flame splitter should be fixed for most heat.



These are repetitions of photographs from apparatus set up in accordance with five of the illustrations given above. In connection with diagrams above, they give a perfect idea of the work.

3. Another method of securing greater heat is the use of the "flower pot" furnace. The flame is protected from draughts, the heat accumulates and work may be done for which a blast lamp is usually necessary.

4. "Where the Sam Hill's that Bunsen burner?" Like the collar button of which we always need several and have but one it turns up missing at just the wrong time. No need to despair, however, when a temporary burner can be rigged from a piece of pipe and a medicine dropper. A hot blue flame can be obtained by adjusting the position of the medicine dropper part or controlling the air inlet with a slip of paper.

5. In many instances high temperatures are to be avoided as for instance in the heating of glassware. A piece of wire gauze prevents the flame from direct contact with the glass.

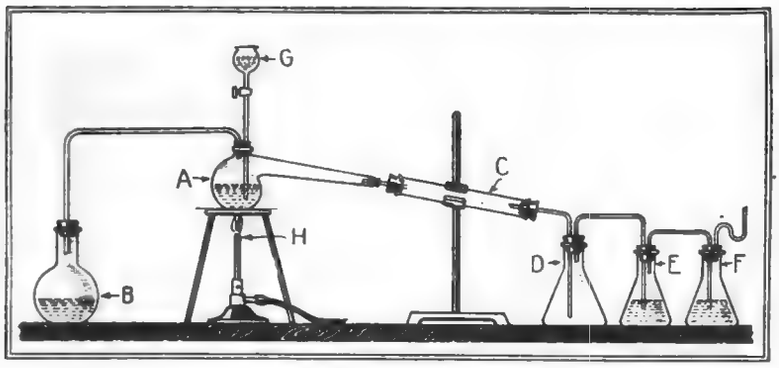
To show the action of a wire gauze screen support a six inch square piece over a Bunsen burner, turn on the gas, and light above the gauze. The flame will burn above only, being unable to get through the meshes and burn below.

6. "Striking back" is an annoyance caused by too rapid combustion. This may be remedied by cutting down the supply of air. When a "strike back" occurs hit the rubber gas tube where it lies on the desk. The sudden compression often sends the flame up to its proper position.

PHOSPHONIUM IODIDE

By CHARLES C. ABBATE

This beautiful compound, which crystallizes in large transparent glittering quadratic prisms, can easily be obtained by placing in a retort, A, of a liter capacity, 400 grams of common phosphorus, allowing an equal weight of carbon bisulphide to run in, and gradually adding 680 grams of pure iodine, care being taken to keep the retort well cooled. The carbon bisulphide is next completely removed by distillation in a water bath, and the retort, A, is connected with a long wide tube, C, placed in a slightly slanting position, and furnished on the lower end with a 250 cc. flask, D, equipped with a two-hole rubber stopper. This is connected to a 150 cc. flask, E, which contains a dilute solution of hydriodic acid. To this is connected another 150 cc. flask, F, containing water.



An interesting experiment in the production of phosphorus iodide is carried out by this apparatus. The reaction occurs in the retort A, the flask B serving to generate carbon dioxide gas to prevent the phosphorus or any of its compounds from entering into combustion.

The object of this arrangement is to absorb the hydriodic acid formed during the reaction, and at the same time to prevent the liquid from entering the wide tube into which the phosphonium iodide is sublimed. The apparatus is then filled with carbon dioxide, which is generated in the generator, B, by the action of hydrochloric acid on calcium carbonate, forming carbon dioxide calcium chloride and water.

Note, however that a current of the carbon dioxide gas is passed through the apparatus throughout the operation. The experiment being thus far arranged, 340 cc. of water are allowed to drop slowly by means of a stoppered tube-funnel, G, into the retort, A, which is slightly warmed.

The heat evolved from the action then taking place is sufficient to sublime the greater part of the phosphonium iodide into the long, wide tube, C. Towards the end of the operation, which usually requires about eight hours for its completion, the retort, A, is heated somewhat more strongly by the Bunsen burner flame, H. When no further increase in the amount of sublimate takes place, the apparatus is dismounted, the end of the long tube, C, is closed with corks, and the thick crust of phosphonium iodide is loosened by means of a stout iron wire and preserved in stoppered bottles. The formation of the phosphonium iodide is represented by the following equation:

$$5I\ 9P\ 16HOH \text{ gives off } 5PH_4\ I\ 4H_3\ PO_4$$

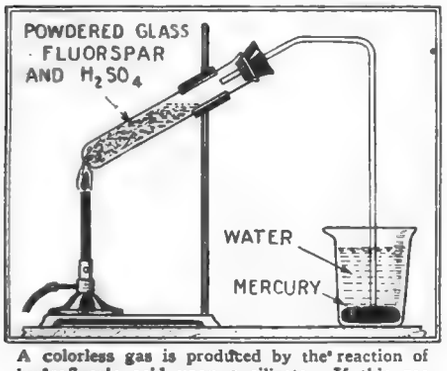
An excess of phosphorous is, in practice, employed because a part of this substance is converted, during the reaction, into the red modification. The formation of the hydriodic acid which escapes is due to the decomposition of the phosphonium iodide in the presence of warm water. Phosphonium iodide boils at about eighty degrees Fahrenheit, but easily vaporizes at a lower temperature. It is used in the laboratory as a powerful reducing agent, as well as for the preparation of many organic compounds.

An Interesting Experiment

By S. WOODALL

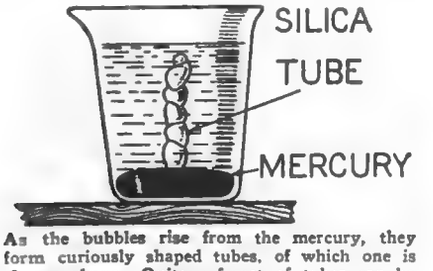
THE production of silica by the action of a gas called silicon tetrafluoride on water, is a peculiar and interesting experiment.

To prepare it by this method, set up the apparatus as shown in the figure. Into a



A colorless gas is produced by the reaction of hydrofluoric acid upon a silicate. If this gas is passed through water it is decomposed precipitating silica. A mercury seal is used for the end of the tube as shown to prevent its choking with the silica.

moderately large test tube put a mixture of equal parts of powdered glass and fluorspar with twice the weight of strong sulphuric acid. The test tube is fitted with a one-hole rubber stopper. A glass delivery tube carries the gas down from the test tube to the bottom of a narrow beaker where it is



As the bubbles rise from the mercury, they form curiously shaped tubes, of which one is shown above. Quite a forest of tubes can be produced.

made to dip below the surface of a small pool of mercury. Water is then poured over the mercury so as to form a column of some inches in height above it, and heat is then applied to the bottom of the test tube. The heat causes the sulphuric acid to react with the calcium fluoride (fluorspar) to form hydrogen fluoride, which immediately reacts upon the silicon dioxide or silica of the powdered glass, to form silicon tetrafluoride as can be seen in the following equation:

$$CaF_2 + H_2SO_4 = CaSO_4 + 2HF$$

Fluorspar, Sulphuric acid, Hydrogen Fluoride

The silicon tetrafluoride is a colorless, invisible gas, as may be observed in the upper part of the test tube. When this body meets the water, it decomposes it, with the formation of silica and an acid containing fluorine, silicon, and hydrogen called hydrofluosilicic acid.

$$4HF + SiO_2 = 2H_2O + SiF_4$$

Hydrogen Fluoride, Silica, Water, Silicon Tetrafluoride

The production of silica in this process allows a very pretty phenomenon to be witnessed. Each bubble of silicon tetrafluoride, as soon as it rises out of the mercury into the water, is converted into a little sack or bladder of silica. When these bubbles are broken, the silica exactly resembles in appearance gelatinous starch as it is used in the laundry. If the bubbles of gas succeed each other slowly, they produce a tube of silica closely resembling one of animal membrane, and extending from the surface of the mercury to the surface of the water.

This appearance, however, cannot be produced at will. The hydrofluosilicic acid in the solution should be separated by filtration from the silica, and saved as a valuable reagent for potassium. The potassium, and barium salts of this acid are insoluble in water and alcohol. The silica left on the filter is exceedingly pure, and when dried, presents itself in a state of very fine division. This process of making silica from hydrofluosilicic acid, supplies us with one of the most convenient methods known of obtaining pure silica.

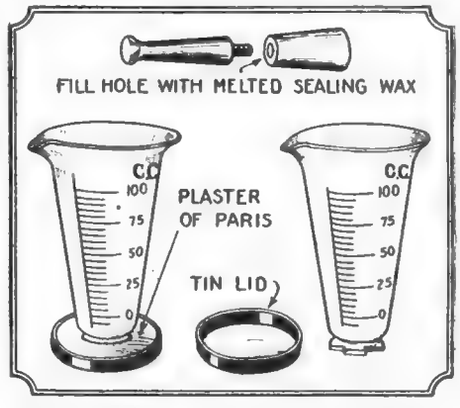
The object of the mercury in the bottom of the beaker, is to prevent the silicon tetrafluoride meeting moisture till it has issued from the tube. If the latter is dipped directly into the water, it would soon become plugged up by the silica produced, and the gas, unable to escape, might burst the test tube or blow out the cork and occasion dangerous accidents.

MENDING BROKEN GRADUATES REPAIRING PESTLES

Quite often the foot on a graduate is broken off, rendering an otherwise good graduate practically useless.

A simple method of "re-footing" graduates is shown in the illustration.

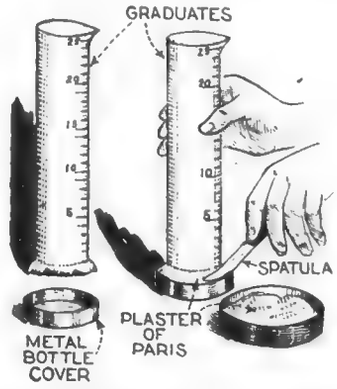
The graduate is placed in a shallow tin lid or tin ointment box of the correct size and the lid is then filled with a thick paste of plaster of Paris or melted sealing wax. The graduate should be supported in an



upright position until the material "sets." It will then "stand on its own feet."

The wooden handles on wedge wood pestles often pull out. They are easily repaired by filling the hole in the "butt" end of pestle with melted sealing wax and replacing handle.

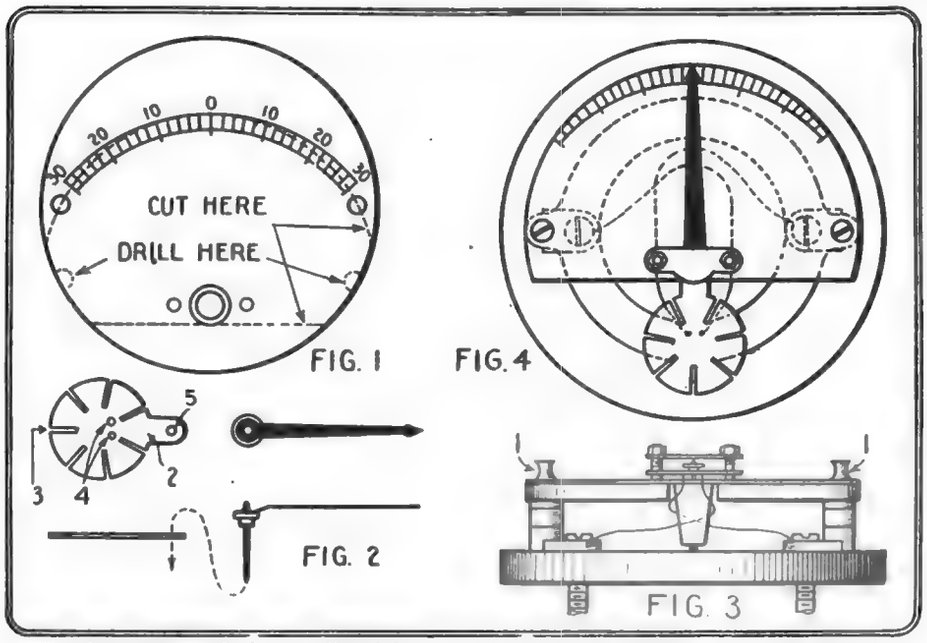
Contributed by Forrest K. Green.



Simple mending operations for the laboratory. With plaster of Paris all sorts of things can be repaired, and it will be found of great use in making up special apparatus. The drawings are self-explanatory. The pestle is mended with sealing wax however. There is one thing to be kept in mind when using plaster of Paris, that it expands on solidifying, and will break a glass vessel if within it. For the outside application it is perfectly safe.

A Sensitive Bridge Galvanometer

By ERNEST F. SHAWVER



A galvanometer made from a discarded automobile dashboard ammeter; as reconstructed, it is of great sensitiveness and it is designed to be used as the indicating instrument on a Wheatstone bridge.

A GALVANOMETER is an essential part of the apparatus for bridge-testing work, but because of the high cost of this instrument few amateur experimenters can afford a bridge for testing resistances, capacitances, inductances, etc.

A galvanometer that is sensitive to very small currents may be constructed as detailed in this article. This instrument is built from an old Weston automobile dashboard ammeter, that has the zero position in the center of the scale.

Remove the case from the old ammeter and take it apart very carefully. The scale plate and the indicator needle arrangement will come off together when the two screws marked 1, and 1, are removed. Lay this part aside to be worked on later. Remove the permanent magnet from its place by prying under it near the supports—pry a little on each side at a time to prevent bending the supports. Now remove the electro-magnet arrangement by filing the rivet head off from the back of the base plate of the instrument and discard it with the inside wiring of the meter. Remove the needle and damping device from the scale plate and cut the scale plate as indicated in Fig. 1, in the sketch. The radius for marking the arc over the top of the scale is just a little longer than the length of the needle and the center is a point ⅛ of an inch above the needle pivot hole. Cut the bottom of the scale plate off straight as is indicated in the sketch. Great care must be taken when handling the delicate needle indicator as it is easily broken off. Cut the part of the damping device, that is fixed to the shaft, off close to the shaft and remove all the little pieces of iron from the lower end of the shaft. This leaves the indicator needle and shaft ready for the mounting of the coil upon it. It will appear as shown in Fig. II.

The turning element of the instrument is a tiny spider-web coil fixed to the shaft of the indicator needle as shown in the sketch. The spider-web form or core is of thin celluloid and the outside diameter is approximately ½ of an inch. Lay the whole thing out on a sheet of celluloid before cutting it out. One segment is left longer than the rest and is shaped as indicated by 2, to fit upon the shaft, and this segment is made narrower than the rest. Set the dividers slightly less than the radius of the form and lay off the segments around the circle, starting at the point 3, and working around the circumference from either side of this point. This will leave the last segment narrower than the rest and that is what is desired. When the form is completed and cut out as shown in the sketch it is ready for the windings.

Wind it full of very fine wire from the secondary of a Ford spark coil making about 50 turns in all. Two holes are then punched in the form as indicated at the points marked 4, and the ends of the winding pulled through them. These ends should be left about four inches long for connecting to the terminals. Punch a small hole at 5, to fit over the shaft. The ends of the winding should be put through their holes in the form and allowed to dangle below. Now the shaft of the needle is slipped into the hole 5, which should grip the shaft tightly. Reassemble the scale plate and the needle with the spider-web coil in place. The whole thing is then put together as before except that the magnet is turned over in order to fit as closely to the coil as possible. Loop the free ends of the winding around to the terminals as shown. Set the center of the coil midway between the poles of magnet and the needle at the zero position. The coil turns against the torsion of the loops of wire which are bent around until the torsion is equal from both sides. Be sure to make this adjustment carefully so that the deflection either side of zero will be the same for the same current.

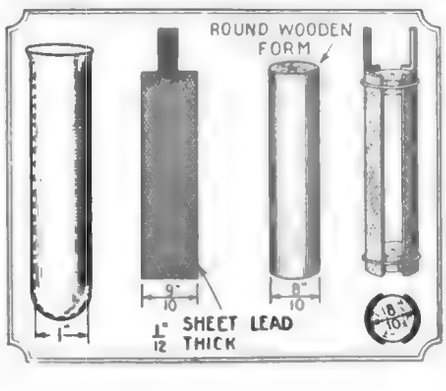
Replace the case and the galvanometer is completed. It should give good results in any kind of a Wheatstone bridge arrangement in which a galvanometer is used.

TOOL LIST FOR BUILDING SENSITIVE BRIDGE GALVANOMETER

Tools required for building this Galvanometer embrace pliers, tweezers, hand drill, files, twist drills, screw driver, tinners' snips, hack saw, hammer and center punch.

Home Made Storage Battery

THE following simple "B" battery has been described by Hans Vatter in a recent German Publication. The example given describes a 60-volt "B" battery requiring thirty cells. The author uses test tubes one inch in diameter and five inches long, and his lead plates are made of sheet lead 1/12th of an inch thick. The lead is cut in strips a little less than one inch wide (2.3cm) and each plate has a lug or ear for the connection. The drawing shows everything. The plates now have to be roughened. They are placed on a flat surface and fine lines are drawn across them using a ruler and a nail and the lines should be close together, sharp on the edges and rather deep. Care must be taken not to go through the plate. By two sets of these scratchings the plate is divided up into a sort of little diamonds or dots. The closer these scratches can be given the better, and they must be given with a sharp pointed nail or steel wire. Each plate now has to be bent into a section



This is a plan of construction for a "B" battery, using test tube as the battery jars, as practically only voltage is required with a very slight current.

of a cylinder, and to do this a wooden mandrel eight-tenths of an inch in diameter is used around which to bend the plates one by one or two by two. This can all be done by hand. Next sixty pieces of the same wood, are needed, doweling may be used, each piece to be ¼ inch long, and these

are to be boiled in melted paraffin, or at least heated to a high temperature therein. When thoroughly saturated, they are fished out of the paraffin and "dried" on a piece of paper. Thirty India rubber bands are required to grip the little plates, and as these must be only about .4 of an inch in diameter, they must be made by cutting sections from a piece of India rubber tubing. Two of the little disks of wood, one for the top and the other for the bottom, hold two of the curved plates apart, and two India rubber bands are sprung around them, and we have our element. A stopper is made for each tube out of two pieces of wood put together with holes for the connecting strips to go through, two for each stopper, and the piece must be also heated in paraffin. As the connecting strips will not fit tightly, there is plenty of chance for the hydrogen to escape. They are filled with battery acid and the plates are formed in the regular way by successive charging and discharging giving what may be termed a little Planté battery.

TOOL LIST FOR BUILDING HOME-MADE STORAGE BATTERY

Tools required for building this storage battery are tinners' snips, scriber, ruler, pan and Bunsen burner, jack-knife, and pliers.

What Happens in a Condenser

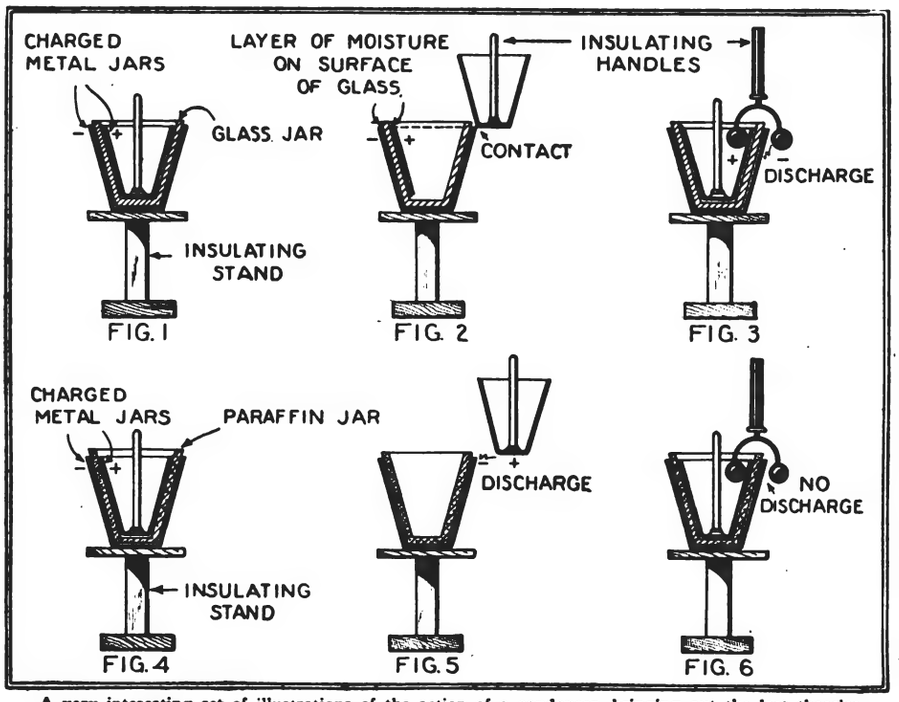
By DONALD H. MENZEL and WINFIELD W. SALISBURY

THE condenser is a very simple and widely used piece of laboratory apparatus yet the theory of its action, as explained in most text-books of physics, is highly complex. In its simplest form it consists of two conducting plates separated by a layer of some insulating substance—glass, paraffin, oil, or air. The so-called Leyden jar, shown in Fig. 1, was one of the earlier methods of constructing a condenser.

Of the various parts of a condenser, the function of the dielectric is the most obscure. When the inside coating of the jar is charged, an opposite charge is induced in the outside coating. The two may be discharged by connecting them. Benjamin Franklin, in 1748, performed a very interesting but puzzling experiment, using the glass jar of Fig. 1. If the conditions are just right, the metal coatings may be removed and found to have little or no charge. They may even be completely discharged by touching, as shown in Fig. 2, put back in place and the jar will be found to have retained almost all of its original charge, giving a considerable spark as shown in Fig. 3.

Franklin explained this by saying that the charge was held in the dielectric of any condenser, as some sort of a strain, and hence remained with the glass when the metallic coatings were removed. In spite of the fact that this explanation cannot be made to agree either with Maxwell's electro magnetic theory, or with Faraday's tubes of force, it has stood for over a hundred and fifty years. It is time that attention be called to the work of G. L. Addenbrooke, M.I.E.E., who has apparently solved the problem completely.

In Mr. Addenbrooke's experiments, the operations described above were repeated with a jar of paraffin instead of glass, as shown in Figs. 4. 5. and 6. The results were exactly those expected from Maxwell's theory. The charge remained entirely on the metal plates and no charge remained after they had been touched. This



A very interesting set of illustrations of the action of a condenser, bringing out the last theories on the dielectric constant of different substances and the reason for the variations.

led to speculation as to where the difficulty lay with the glass jar. Further experiments, under different conditions, disclosed that when the glass had been thoroughly dried and when the experiment was performed in dry air, it behaved exactly like the paraffin jar.

This, and still further experimentation led to the conclusion that, due to the hygroscopic (water absorbing ability) nature of the glass usually employed in Leyden jars, there exists a conducting film of moisture on the surface which is the actual plate of such a condenser, and on which the charge remains when the metal plates, which act only as connectors, are removed.

The charge in a condenser is, therefore, due to the presence of electrons on the surface of the conducting plates. This is consistent with Maxwell, Faraday, and the modern electron theory. It is hoped that authorities will soon correct text-books with their misleading impressions of the past, and add this evidence to the consistency of science.

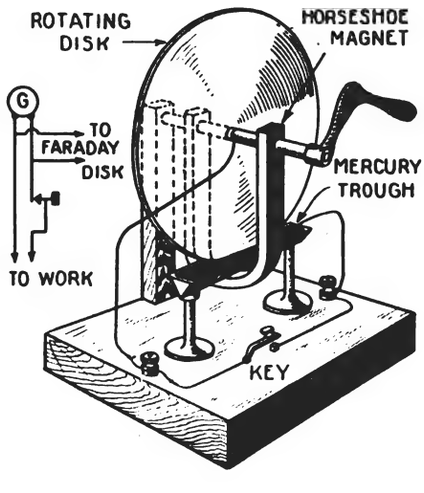
Arresting the Deflections of a Galvanometer

By SAM FISHMAN

IN a laboratory in which many galvanometer deflections had to be read in rapid succession, a novel method was used to bring the under-damped or over-damped galvanometer back to zero. A Faraday's disk was built and placed across the galvanometer terminals and was left in open circuit. After the deflection was read, the disk was put into the circuit and by a slight rotation the galvanometer was brought to zero.

A Faraday disk is used to give a minute current to bring a galvanometer to the zero point after it has been deflected. A very interesting application of this classic instrument.

The Faraday's disk consists of a copper disk mounted on an axis, so that it rotates between the poles of a horseshoe magnet. The edge of the disk dips into a mercury trough. Rotating the disk sets up an induced voltage, and by closing the circuit a small current is obtained.



Faraday's Disk is a classic in the history of electricity. Its principal and practically its only use in the past, has been to serve as an experimental demonstration of induced currents. It is reversible, that is to say, it can be used as a generator or as a motor. It is as reversible as the regular wound type of motor operated by the electric current.

The fact that it is weak protects the galvanometer from harm as its incapacity for giving a strong current as well as the lowness of the potential which it generates enables it to serve its purpose—the very features which seem to be its defects telling in its favor. There is very little strain involved in its manipulation.

TOOL LIST FOR BUILDING FARADAY DISK

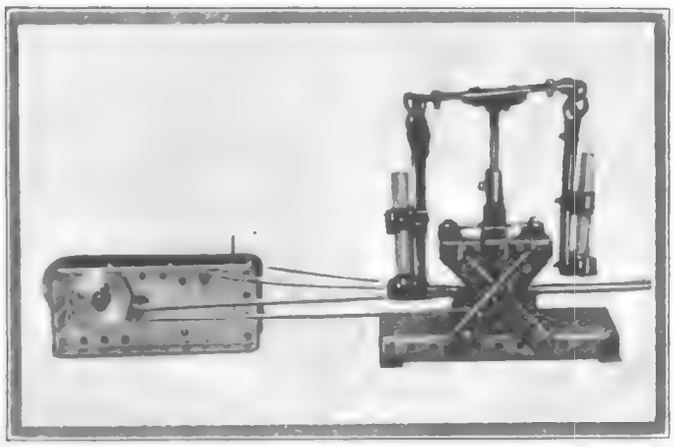
Tools required for building the Faraday Disk embrace hack saw, hand drill and twist files, hammer, center punch, circle cutter of dividers.

THE CONSTRUCTOR

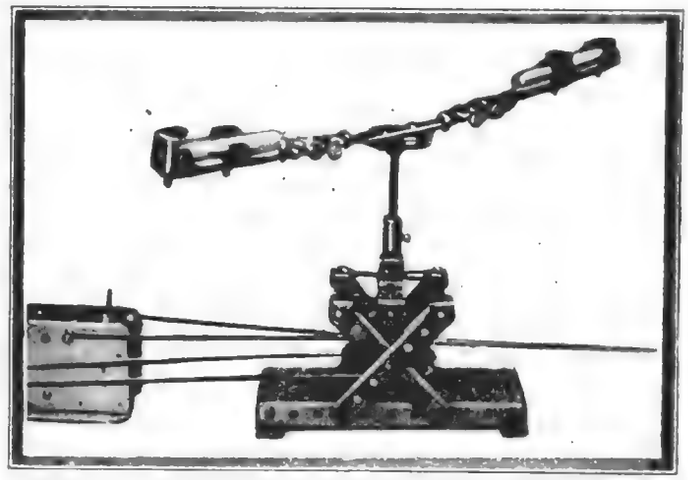
"LAB" Apparatus From Toy Girders---

Using Toy Construction Parts for Useful Laboratory Apparatus

By DR. ERNEST BADE



General view of centrifuge and electric motor for rotating it as built by Dr. Bade from toy constructor parts. If good parts are used and properly arranged, the device makes a practical addition to the chemist's laboratory.



Close-up view of the centrifuge in action, the two test tubes and their contents being rapidly whirled around by the motor seen at the left. The motor may be run by dry cells.

THE better grades of toy construction sets on the market today which are made with precision instruments and incorporate all of the important mechanical devices for reproducing movements can be used for the building of the most complicated structures. Since all of the parts are standards in miniature, they are all interchangeable among themselves and thus make possible the reproduction of model machines, with all the complexity of the original as well as the new devices and new movements.

The child may play with such construction sets and he may even build the most elaborate mechanical devices with all their intricate movements but still it is only a toy. But when he is older and begins to experiment on a more serious scale, these same construction toys are of inestimable value for him. By childhood experience he has realized that all possible mechanical movements may be made with them, that any structure may be made exceedingly strong by the application of sound engineering principles and he will carry out the things he has learned while building what were virtually toys, in constructing instruments and devices which he expects to use in his laboratory.

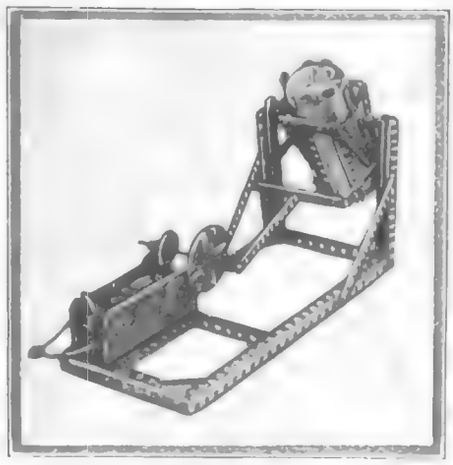
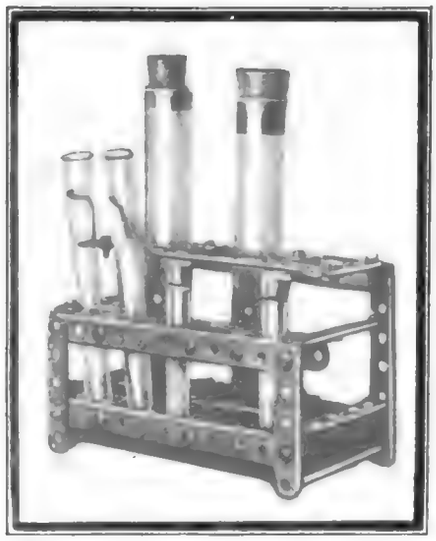
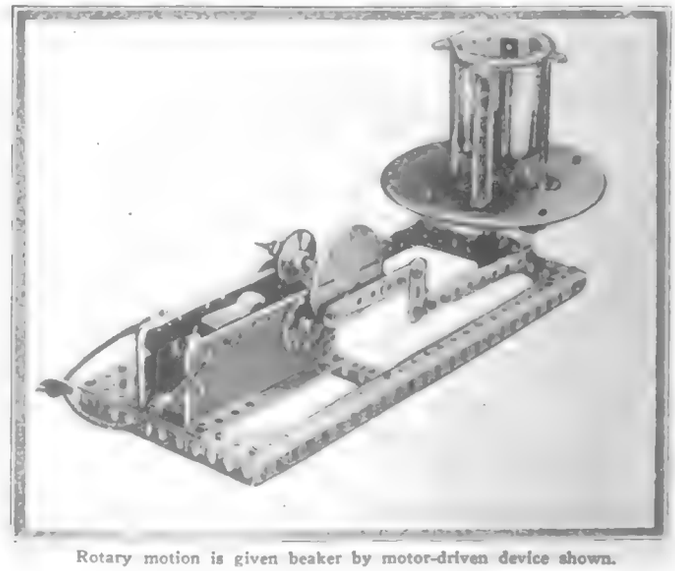


Photo above shows a test tube shaker comprising an oscillating carrier which is moved back and forth by crank connected to a disk on the electric motor.

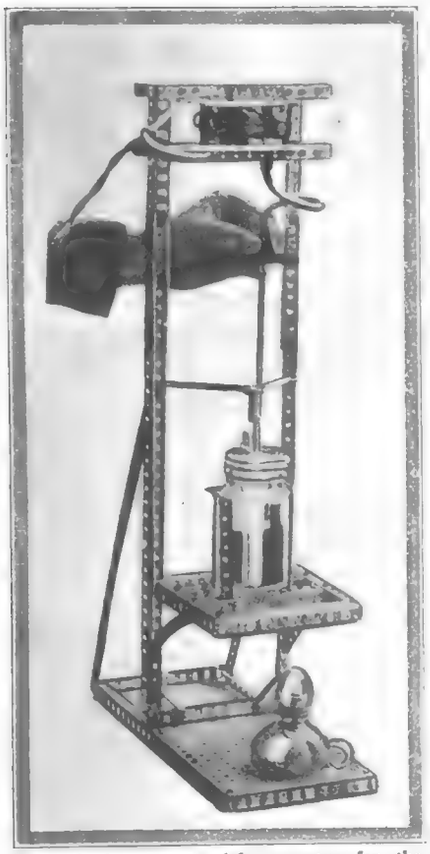
In the electric motor he has a device that saves him much labor and time in carrying out his experiments and since a powerful motor usually accompanies a toy construction set and since it may be attached in any desired position, he is enabled to build an apparatus which, if he bought it, would cost him so much money, especially if his means are limited, that he would far rather do without it. But still, if he is fortunate enough to have one of these construction sets, he can build the machine or device that he needs most at any given time and, when the need for it has passed, he can take it apart and build an entirely different device. This is a thing impossible with a bought machine. When the use for it has passed,



Toy constructor parts are useful in making test tube rack at left



Rotary motion is given beaker by motor-driven device shown.



One of the most useful apparatus for the chemical laboratory and also the home is the motor-driven stirrer shown above.

the machine becomes a dust collector of the first order, until it is again pressed into service many weeks and often months later.

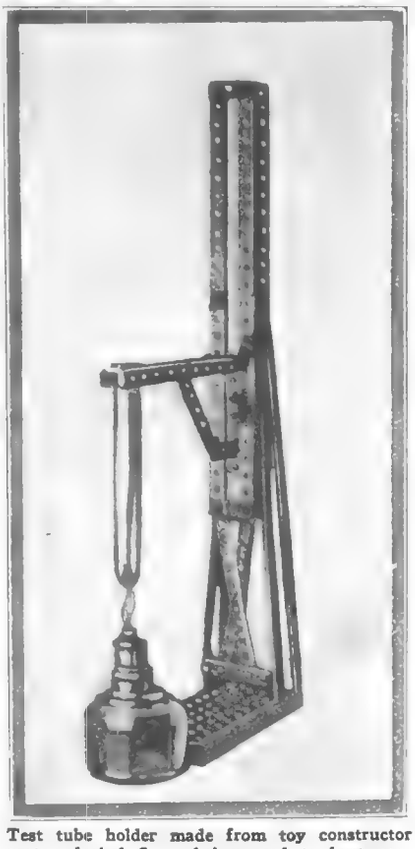
One of the simplest devices to make from a toy construction set is a centrifuge and when made with a Meccano set, which contains strong steel strips and brass machine-cut, not stamped, gears which mesh accurately, little vibration is produced. Since the electric motor can be used for many devices, it is mounted to one side so that it may be removed easily and used for other purposes. For ordinary work two test tube holders are usually sufficient although more may be provided. Some of the many uses to which it can be put are rapid settling of fine precipitates, the separation of oils from water and, at times, the breaking up of emulsions.

The construction is very simple. It consists of a base and a pair of uprights, supporting a comparatively long shaft, near the lower end of which there is a pulley wheel, while the upper end carries hinged test tube holders, the hinges being made with bent wires.

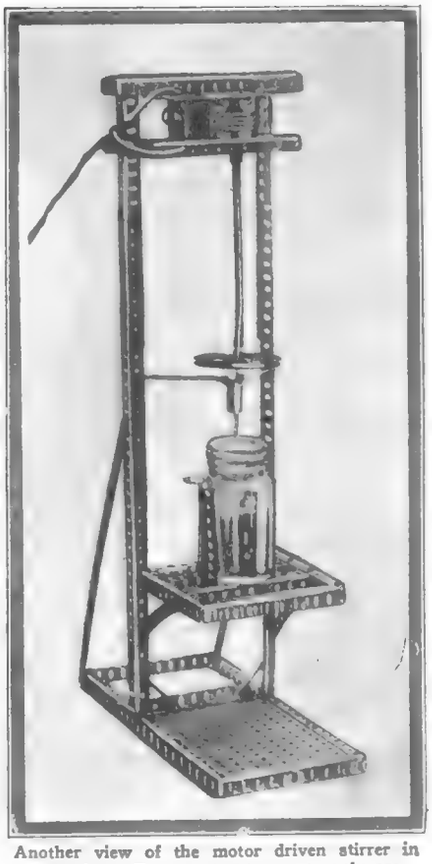
Slightly more difficult is the bottle churn for the violent agitation of liquids and the production of emulsions. This device is nothing more than a small wagon runing on a track. The wagon, which must be of sufficient size to hold the bottle firmly, is directly connected to an eccentric or the outer rim of a large wheel by means of a strip or shaft. Then, when this wheel is turned, the shaft is carried back and forth, rapidly throwing the wagon with the bottle first in one direction and then in the other. This keeps the contents of the bottle violently agitated. An electric motor is, naturally, the motive power.

A similar principle is employed for a test tube shaker. Here the test tube can be left open if the contents do not rise more than 2/3rds above the bottom. This keeps the tubes gently agitated. The principle employed is that of the swing, and the gentle sway, although quite fast will prevent the settling of even the heavier precipitates. This shaker is especially adapted for some organic work.

An oscillating rotary movement to a beaker to keep its contents stirred up without spilling is obtained by attaching an arm to a large rotating wheel, an eccentric, and fastening the other end to the outer rim of a horizontal plate. Then, when the motor is running, the arm oscillates back and forth, pulling and pushing the plate for a distance of about 1/3 of its circumference about its axis. If now a beaker is placed in a holder attached to the plate the contents of the vessel will be thrown first in one direction and then in the other.



Test tube holder made from toy constructor parts, alcohol flame being used to heat contents of tube.

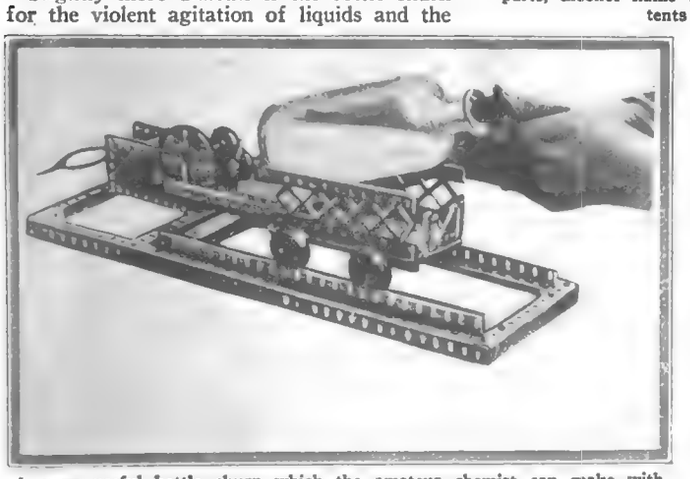


Another view of the motor driven stirrer in operation. Toy constructor parts only are used.

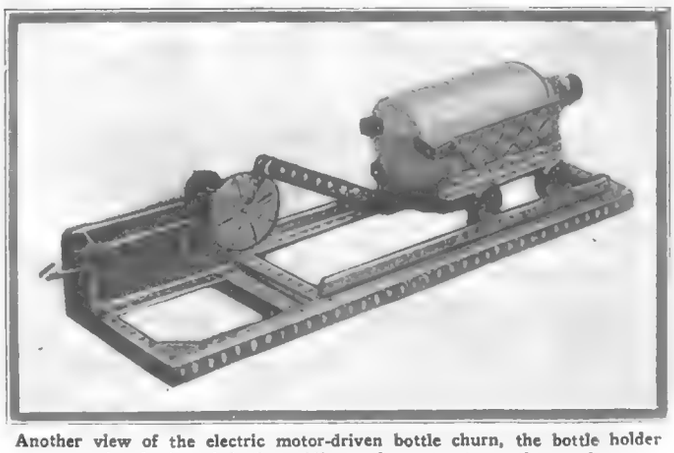
Probably one of the simplest of all devices used in the chemical laboratory is the stirrer. The stirrer itself is a closed glass tube or solid glass rod, bent on its lower back upon itself a number of times. The upper end of the tube or rod is provided with a fly-wheel to make its rotation smoother and it is attached to the motor by means of a piece of heavy rubber tubing extending between glass rod and the hub of the wheel. The rubber permits the stirrer to be lifted up out of the vessel. If desired, the vessel may be placed on a shelf and below it a small flame may be placed to give the contents of the container the benefit of a hot air bath whenever heat becomes a necessity.

TOOL LIST

The tools desirable for building the apparatus described here comprise: pliers of different types, several sizes of screwdrivers, hack-saw and blades, hammer, hand-drill and twist drills, rule and scriber.

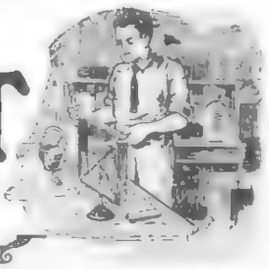


A very useful bottle churn which the amateur chemist can make with little trouble from toy constructor parts, plus electric motor.

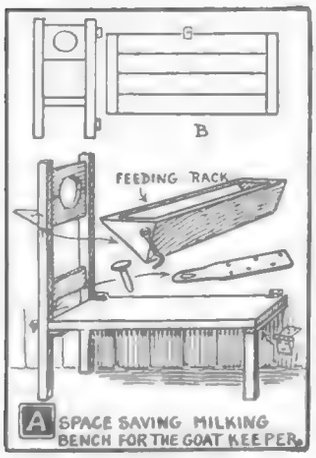


Another view of the electric motor-driven bottle churn, the bottle holder moving back and forth rapidly as the motor turns the crank.

HOW TO MAKE IT



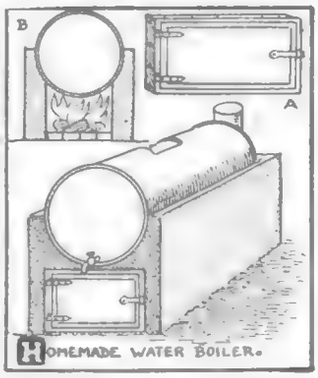
CONVENIENT MILKING BENCH



The milking bench illustrated here is very useful where space is limited, as it can be folded up out of the way. It is made from scantling and 1-inch lumber. The leg is hinged so that it can be folded up, and the feed-rack is hung with hooks, to be easily removed when not in use. The device is inexpensive and easily made.—T. Sheward.

HOME-MADE WATER BOILER

A very good boiler for heating water can be made from an old gasoline drum set in concrete as shown. A hole is made in the top for filling the tank, and a cap placed in one end for drawing off the water. The base is made of cement in which may be inserted a stove pipe chimney and iron door. —T. Sheward.

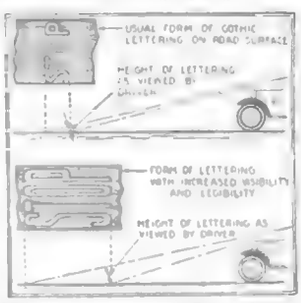


WOODPECKER'S HOUSE

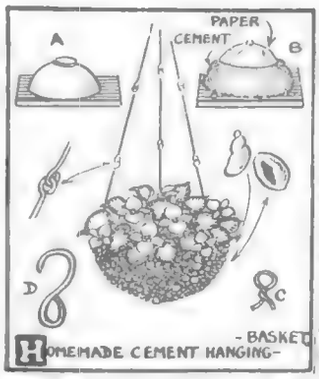
The woodpecker house illustrated is made by splitting a log, gouging it out, and hinging the two parts together. A flat piece of wood or zinc nailed on top makes the roof. It can be fastened up in a tree in the garden. — T. Sheward.

ROAD SURFACE SIGNS

The ordinary style of lettering is highly distorted when viewed from an angle, so highway engineers have developed a system of perspective lettering, which gives a much greater visibility and readability, for use in road surface signs. —G. A. Luers.


USUAL FORM OF GOTHIC LETTERING ON ROAD SURFACE
HEIGHT OF LETTERING AS VIEWED BY DRIVER
FORM OF LETTERING WITH INCREASED VISIBILITY AND LEGIBILITY
HEIGHT OF LETTERING AS VIEWED BY DRIVER

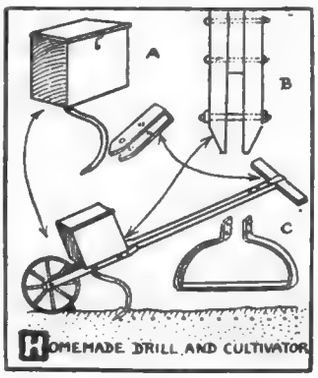
CEMENT HANGING BASKET



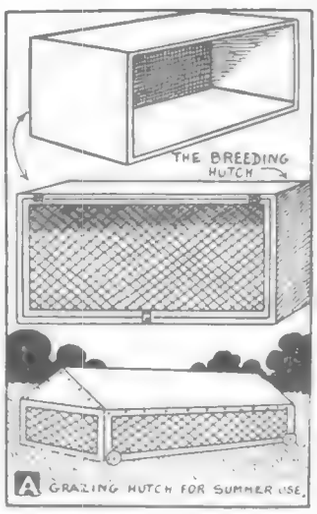
The hanging basket shown here is made by placing a bowl, A, on a piece of wood, covering it with paper, building cement over this and allowing it to dry for a few days. Three parts sand and 1 part Portland cement are mixed to a thick mortar and later decorated with shells and colored stones. C and D show wire fittings used. —T. Sheward.

DRILL AND CULTIVATOR

Another seeder which may be adapted for use as a cultivator may be constructed by following the design given at the right. The details of construction are also given. The seeder may be used as a cultivator if an old buggy tire is shaped as at C and fastened in place of the seed-tube. —T. Sheward.

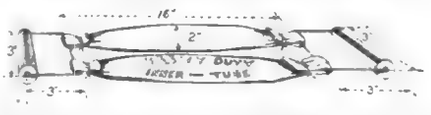


RABBIT HUTCHES



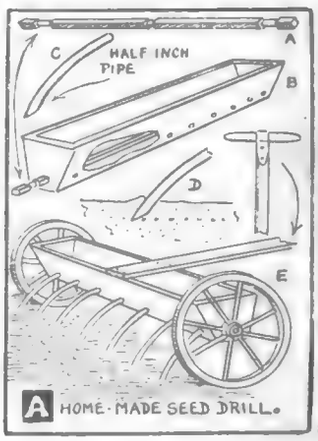
The drawings at the left show inexpensive breeding and grazing hutches for the rabbit fancier. They are constructed from light packing cases and enclosed at the sides and bottom with strong wire screen. It is well to keep in mind that rabbits can burrow out of an enclosure in a very few minutes, which makes it necessary to take unusual precautions against escape. — T. Sheward.

CHEAP EXERCISING MACHINE



Two heavy inner tubes connecting strong pail-handles make a very useful "muscle stretcher" for the amateur gymnast.—Einer Lehti.

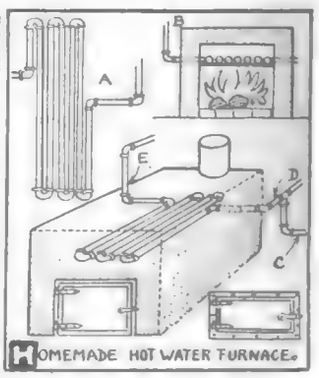
HOME-MADE SEED DRILL



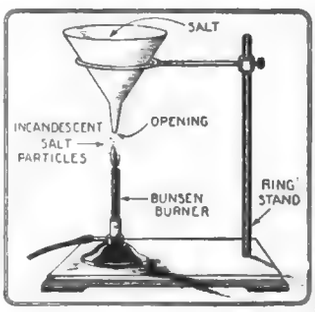
A very useful seed drill can be made from two old wheels, a box, and some pieces of scantling. The seed trough is made from light lumber, short pieces of half-inch pipe are bent and sharpened to cut into the soil, and are placed in holes in the seed box. The square axle runs through the seed box and agitates the seeds as the seeder is pushed along. —T. Sheward.

HOME-MADE HOT WATER FURNACE

A good hot water furnace for heating green houses can be made of concrete at a very low cost. A coil of pipes A, is supported as at B on iron bars over the fire. E is the flow, D the return, and C the cold water inlet. The rise in the flow pipe will reach at maximum, some 20 feet. —T. Sheward.



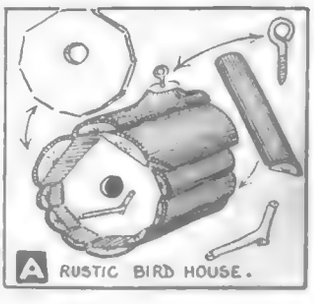
SODIUM FLAME GENERATOR



The chemical experimenter often finds it necessary to produce a yellow sodium flame for study with a spectroscope, but is handicapped by lack of apparatus. A very good bright yellow flame will be produced by the device shown here.—F. Ebel.

RUSTIC BIRD HOUSE

This rustic bird house is made of nine-inch cedar slabs nailed to two pieces of half-inch dressed lumber six inches in diameter. When finished it is hung in a tree in the garden and is a suitable home for wrens. —T. Sheward.



WRINKLES
RECIPES & FORMULAS

Edited by S. Gernsback

Repairing Leaky Carburetor Float

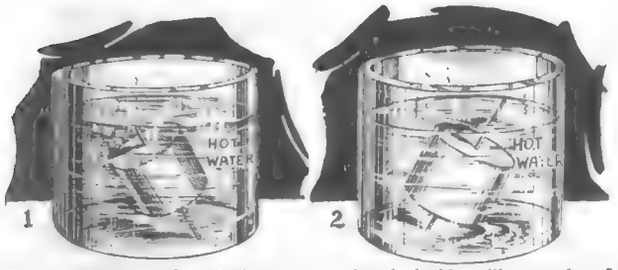
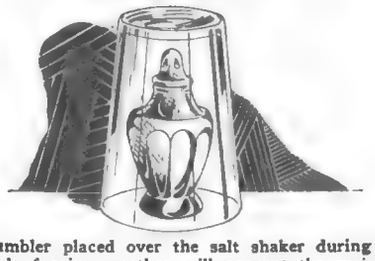


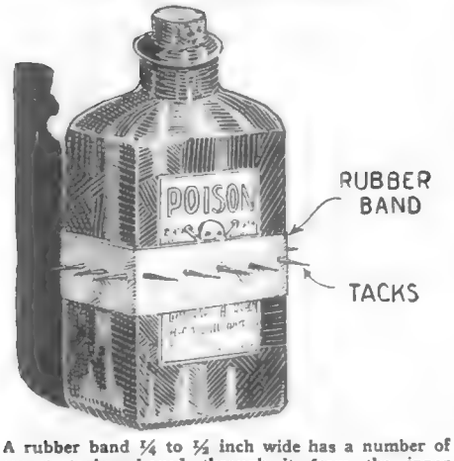
Fig. 1. Immerse float in hot water; the air inside will expand and bubbles will show point of leakage. Fig. 2. Enlarge leak and immerse float with hole downward so expanding air can force gasoline out. Fig. 3, Carefully solder up hole while float is partially immersed in ice water.

Keeping Salt Dry



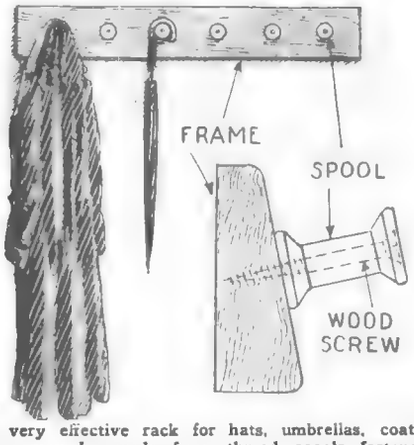
A tumbler placed over the salt shaker during the period of rainy weather will prevent the moisture in the atmosphere from causing the salt to cake. Another method is to mix a small amount of cornstarch with the salt to prevent it from absorbing moisture.

Poison Bottle Marker



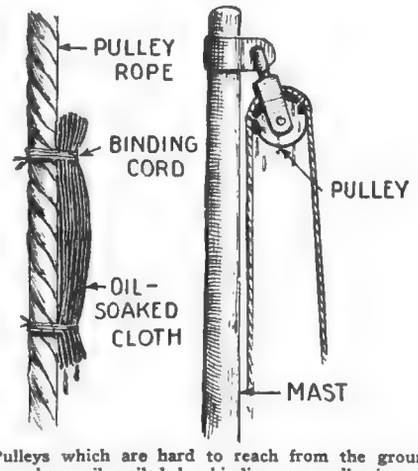
A rubber band ¼ to ⅓ inch wide has a number of carpet tacks shoved through it from the inner side. The tacks are spaced about ½ inch apart and afford an excellent protection, by serving for warning as to the contents of the bottle.

Easily Made Hat Rack



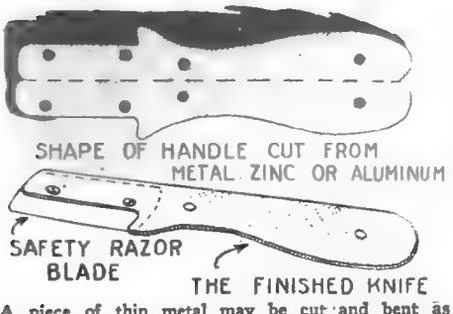
A very effective rack for hats, umbrellas, coats, etc., may be made from thread spools fastened with long woodscrews to a narrow board. The heads of the screws may be countersunk, and a sloping front to the board will improve the appearance.

Oiling Aerial Pulleys



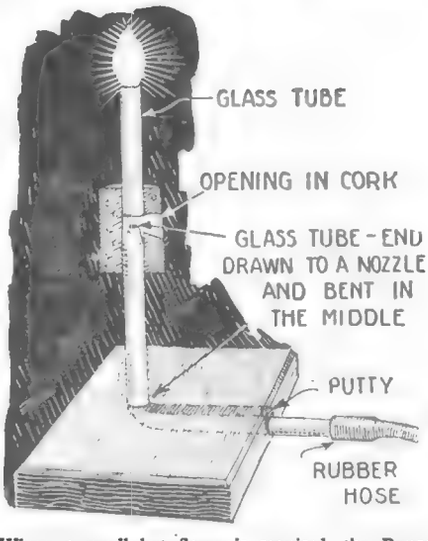
Pulleys which are hard to reach from the ground may be easily oiled by binding a small piece of oil-soaked cloth to the rope and pulling it through the pulley.

Razor Blade Knife



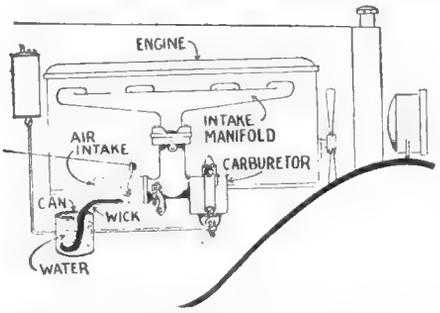
A piece of thin metal may be cut and bent as shown above to form a handle for discarded safety razor blades, which will permit them to be used for numerous small jobs about the house.

Improvised Bunsen Burner



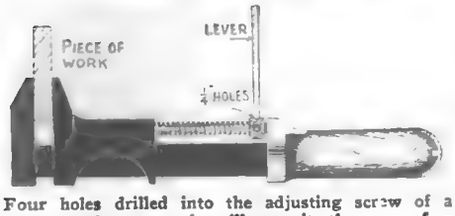
Where a small hot flame is required, the Bunsen burner illustrated above may be quickly improvised. A piece of ¼-inch glass tubing is bent at right-angles and one end is drawn to a fine nozzle. Another short piece of straight tubing in inserted into a cork cut as shown, to admit air for a proper burning mixture. The assembly is mounted in putty on a wooden baseboard for stability.

Reducing Motor Carbon



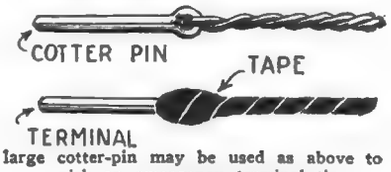
An ordinary lamp-wick, one end of which is inserted into the intake manifold of the automobile carburetor, is placed in a can of water anchored securely to the cowl. Moistening the air supply reduces carbon and improves general efficiency.

Small Parts Vise

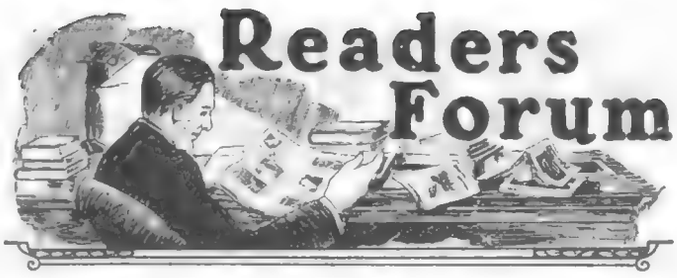


Four holes drilled into the adjusting screw of a large monkey wrench will permit the use of a lever for gripping small parts.

Emergency Terminal



A large cotter-pin may be used as above to furnish an emergency terminal tip.



SCIENCE AND INVENTION desires to hear from its readers. It solicits comments of general scientific interest, and will appreciate opinions on science subjects. The arguments pro and con will be aired on this page. This magazine also relishes criticisms, and will present them in both palatable and unpalatable forms. So if you have anything to say, this is the place to say it. Please limit your letters to 500 words and address your letters to Editor—The Readers Forum, c/o Science and Invention Magazine, 53 Park Place, New York City.

NOAH'S ARK.

Editor, SCIENCE AND INVENTION:

In the October issue of SCIENCE AND INVENTION Magazine, I notice that the Ark story takes an important place. The article takes up the question as to whether the Ark was large enough to hold all of the animals. The article seemed to sustain its point; the possibility of Noah's Ark. How about its probability?

According to the Bible story, the descendants of Adam had just become too wicked for any use at all, so God decided that he would have to drown all of them except Noah and his family, who alone deserved to be saved. Noah, it seems had been a bachelor for five hundred years, but he finally decided to marry and raise a family. So it was in his six hundredth year that he completed the Ark and fitted it for a most momentous voyage. The Ark was five hundred feet long, eighty or ninety feet wide and fifty-five feet high. There was one door on the outside and one window twenty-two inches square. This establishes Noah as the world's foremost authority on ventilation. Into this Ark Noah ushered two of each kind of animal on the face of the globe. (The earth wasn't exactly a globe then, according to the Bible. It had four corners, and was flat. Copernicus started the movement to change the shape from flat to round.) There were no plants saved; evidently there were no xerophytes or mesophytes in those days. Beyond all doubt, Noah had quite a task counting out the thousands of mammalia, reptilia, and insecta, but the separation, two by two, of the tiny protozoa, without even a semblance of a microscope, puts Noah far above our best protozoologists. As a man of keen sight and meticulous observation and perseverance, Noah deserves our everlasting homage.

It must have indeed been an unforgettable sight to see all of those animals gather, prior to entering the ark. The polar bears probably came all the way from Greenland. Friendly animals probably informed them of the exact whereabouts of Noah. The kangaroo probably hopped all the way from Australia. The American animals had to swim across the Atlantic, a feat that puts all channel swimmers in the shade. When the animals were all safely aboard the ark, and the door and window were shut, then the rain began. Forty days it rained until the water covered the highest mountains. On the average, the water was about five and a half miles deep. It had come down at the rate of over eight hundred feet per day, which is going some for dampness. The story says that the windows of heaven were open. It looks as though a couple of doors were also open. After cruising around for one hundred and ten days the good ship ark finally came to rest on top of Mount Ararat, a peak seventeen thousand feet above the sea, crowned with three thousand feet of snow. We imagine that the tropical animals enjoyed coming out of the ark in a climate so different from their native habitat. The American mammals probably had to borrow the ark to go back home in. That would have been lots better than swimming back.

Further on the story says that God put a rainbow in the sky, saying: "When I see that I will recollect that I have promised not to drown you." There are other rainbow theories, but you can readily see that this is the only true one. Scientists can say what they please, but the meaning and cause of rainbows needs no study, the question has already been settled.

Perhaps other readers have probed the Ark story with deeper insight. Their opinions of this marvelous narrative ought to be highly interesting and instructive to every intelligent man, especially those very numerous readers of SCIENCE AND INVENTION Magazine. JOHN G. JACKSON, JR.,
New York City

(Your letter of September 24th to hand, and we would make the following reply in regard to your questions concerning Noah's Ark, the article on which appeared in the October issue of SCIENCE AND INVENTION *Magazine.*

Most of your questions concern of course the possibility that Noah's Ark was actually built, and how Noah, even with considerable help perhaps managed to gather all the animals from the far ends of the earth.

This is a very large subject, and as you will remember in reading our article we did not take up any such issue as the possibility or impossibility of Noah having constructed the Ark, and having gathered animals from various parts of the earth in accordance with the Biblical tale. We wish to preserve our absolute neutrality on this point, as it seems to us from our extensive experience with subjects of this nature, that it is up to the individual in every case, and it really amounts to a question of personal religion as to whether the individual cares to accept or reject the story of Noah and his Ark.

There are many devout students of the Bible, referring for the moment to the so-called modernists, who do not believe in all the Bible tales, such as Noah's Ark, the virgin birth of Jesus Christ, and many other narratives which appear in that venerable book. The fundamentalist, on the other hand, would have everyone swallow every tale in the Bible just as it is written. Our viewpoint is that the fundamentalists are partly right and so are the modernists, and as you will at once see, it is splitting hairs pretty fine and treading on dangerous ground indeed for anyone to take a given stand and say he believes this and does not believe that, et cetera.

Many of the questions raised in your letter are answered from a scientific point of view in a very excellent article which contains the transcription of a very ancient stone tablet just deciphered by the archeologists of the University of Pennsylvania, this article having appeared in the Sunday American Magazine for Sept. 12th, 1926, copy of which you can obtain through your news dealer. According to the translation of the characters on this most interesting tablet, the ark as built by Noah, was about twice the length of the ark mentioned in the Bible narrative. This of course simplifies the matter of taking care of all animals that existed in Noah's time and the necessary food.

There are a number of other very interesting scientific points brought out in this article as follows. Drinking water for the animals could have been obtained by gathering rainwater from the upper deck and cabin roofs of the ark. Noah probably did not select two of the largest specimens of each species, but picked out young animals which would occupy far less space than full sized adults. Another important point is that these small animals would eat much less food, and during the year's sojourn on the ark they would also hibernate and sleep for many months no doubt. Plant life would not be destroyed by the flood, at least the roots and seeds, and these would take care of themselves when the waters receded. It is also interesting to consider that after thinking over the above statements, that as the small animals grew larger during their sojourn on the ark, and the food took up less and less space, this automatically provided more space for the growing animals.

If you have talked to many Bible students and preachers of the Gospel of the present day, you will no doubt obtain a much wider viewpoint of all things pertaining to the Biblical tales, chief among these being the fact that many of the passages in the Bible were no doubt written many years or centuries after they occurred, and those who wrote them finally did so from memory and from tales handed down through generation after generation of people. Another salient point to be remembered, as many modern preachers of the gospel have rightly stated, is that a great many of the tales which we read today in the good book were written in a time far different from ours, and for an oriental people who had to have stories told or written in a big way to stir them. As one eminent preacher put it, there is probably a gist of truth behind each of the Biblical wonder stories, such as Jonah and the Whale and Noah's Ark, but the actual facts in the case have probably been changed somewhat as they were handed down generation after generation, and finally recorded for posterity by some scribe, who decided to write it in a clay tablet or in some other form, years after the actual occurrence of the event.

The trouble with many students of the Biblical tales of miracles or near miracles is that they fail to think for a moment that the earth was probably far different in its land and water make-up than it is at present. In a very interesting article which appeared in "The Scientific Monthly" for July, 1925, you will find some wonderful food for thought, and some scientific data which will no doubt change your opinion as to how Noah might have gathered the animals to the ark and also, which is just as important, how the animals were probably distributed after the Noachian Deluge. One scientist's belief is that North and South America were once joined to Europe by a land bridge, or in fact constituted an actual part of Europe and Africa. Unless we find some much older records than have so far been unearthed by our archeologists, we will probably never know just exactly the arrangement of the continents and seas on the earth thousands of years ago. Some letters we have received talked in terms of 4,000 years B. C., or a total of 6,000 years since the beginning of the earth, according to the Bible. People who mention such facts as these are not thorough students of the Bible and apparently do not know that the dates given beside the various passages in the Bible are those suggested by Bishop Ussher quite some years ago. The Bishop was an excellent student of the Bible, but in many ways the dates as suggested by him have caused more trouble than they have good. The date of the Noachian Deluge is probably far earlier than we at present suspect. We shall probably never know from what year or century the early facts stated in Genesis were handed down though hundreds and perhaps thousands of generations before they were recorded for posterity.

Great earthquakes, the close approach of heavenly bodies and other vast and titanic astronomical events could and no doubt did occur, which caused mountains to be thrown up, and even continents and seas to be changed, as the centuries went by.

Another view often taken of such Bible narratives as that of Noah and his Ark, is that it is quite conceivable that the civilized world as Noah knew it was a very small section, probably as big as Europe today. This would make it comparatively easy to gather the various specimens of animals, insects and reptiles. Another important scientific consideration, based upon evolution, is that Noah need not necessarily have had to gather two or more of all the mammals, insects and reptiles we know today. On the theory of evolution, it is at once conceivable that with a relatively small number of mammals and other forms of life, the world could easily have been repopulated by the production of new species as the years went by. This could not have occurred in 4,000 years to any great extent perhaps, but no one has proved or probably ever will prove that Bishop Ussher's 4,000 B. C. marks the beginning of the world. This figure is purely arbitrary. According to our geologists, the Noachian Deluge and repopulation of the earth may have occurred a million years ago or fifty million. No one will ever know.

We have received hundreds of letters about the Noah's Ark story, but most of them deal with, we might say, almost a personal aspect of the narrative as we mentioned previously, i. e., it really depends in the final analysis, on the individual viewpoint in every case. We note from many of the letters that the writers apparently did not accept the Noah's Ark story at all, and we have nothing to say of course in that respect, and could not if we cared to, if we follow the ethics of the editorial profession in getting out a non-sectarian magazine such as SCIENCE AND INVENTION. *It is well to remember, if you have any religious faith at all, that many things could happen under the Divine influence that simply could not occur or happen from the cold scientific point of view, as entertained by some of our modern students on such matters as these.*

It is well we think, to take a broad general view of the whole situation, and not try to consider a subject like Noah's Ark, or any of the other Biblical tales from a cold scientific point of view, which is quite likely to be too materialistic. In other words, such an investigator will tell you that what he cannot see logically or otherwise could never happen. Miracles are happening today just as they did thousands of years ago, and just because we know a good deal more of science in all its branches today than our forbears, is no reason why at all that we should sit on a throne and condemn everybody else's opinion, even if it was expressed in writing centuries ago.—Editor.)

AMAZING STORIES IN THE DECEMBER NUMBER:

"THROUGH THE CRATER'S RIM," by A. Hyatt Verrill. A brave explorer sets out to find an entrance into "The Lost City" and the story tells of his exciting and dangerous adventures, his experiences in the lost city and his timely rescue from these strange people.

"THE FIRST MEN IN THE MOON," by H. G. Wells. This is undoubtedly one of the greatest moon stories ever written. It is safe to say that only a Wells could think of the most amazing creatures that he describes so vividly. Don't fail to read this amazing story.

"THE TIME ELIMINATOR," by Kaw. This is a scientific love story. By utilizing light waves produced in the remote past, the events of preceding centuries and years are thrown upon a screen and a bride is won thereby; but how?

"THE SECOND DELUGE," by Professor Garrett P. Serviss. The second installment of this engrossing story. Read about the Noah of the future, who built his ark out of a marvelous light metal of the coming ages.

"THE DIAMOND LENS," by Fitz-James O'Brien. This is one of the world's classics in the realm of scientific fiction.

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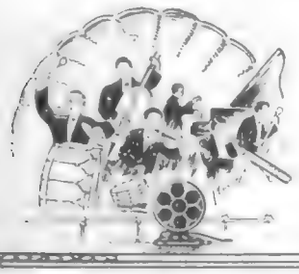
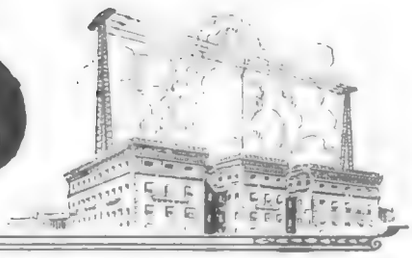


RADIO



WRNY Changes Transmitter Location

The Radio News broadcasting station WRNY, formerly located at the Hotel Roosevelt, 45th Street and Madison Avenue, New York City, announces the removal of its transmitting equipment to a more favorable location at Coytesville, N. J. Considerable trouble was experienced in the old location, due to the fact that the transmitter was in the most congested section of New York City, surrounded on all sides by skyscrapers. The owners decided that it would be advisable to relocate at a point on the Palisades just opposite 188th Street, Manhattan, retaining the original quarters at the Roosevelt for use as a studio. The three line cable carrying WRNY's programs now makes the twenty-seven mile circuit shown on this photograph of the city. The cable runs from the Roosevelt (A), to the Vanderbilt exchange (B), thence to the Longacre exchange (C), through the Pennsylvania tunnels to the Union exchange in Jersey City (D), to the Leonia exchange (E), and finally to the new plant at Coytesville.

The next time you hear the voices of SCIENCE & INVENTION Magazine's editors, you will be listening to WRNY from its new location to which it was recently transferred at a cost of $15,000 00. The antenna, 527.5 feet above the Hudson River, points directly across the M district, and assures our listeners of a more satisfactory recep interference and, we hope, greater DX.

Six Tube-Shielded T.R.F. Set

Three Stages of Shielded Radio-Frequency Amplification, a Shielded Detector Circuit, But Only Two Controls Are Features of This Exceptional Broadcast Receiver.

By A. P. PECK, Assoc. I.R.E.

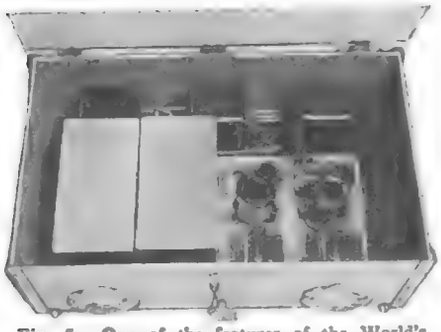


Fig. 5. One of the features of the World's Radio Fair was this two-control shielded set in its beautiful mottled green cabinet made of milk.

AT the recent World's Radio Fair at the New Madison Square Garden, New York City, one of the radio receiving sets which attracted wide interest made use of a novel circuit and a very unusual assembly of apparatus. Furthermore, the cabinet and dials were of such a distinctive appearance that they caused extensive comment. Probably very few of the people viewing the exhibit realized that the material used for both the cabinet and dials was *milk*. This material, with its mottled surface is made by a special process from the casein contained in milk. The set under discussion was constructed by Mr. L. A. Brams of Brooklyn, N. Y., and uses a 6-tube circuit having several novel features.

The illustration, Fig. 1, shows the outward appearance of Mr. Brams' set. Probably the average radio constructor will not want to go to all the trouble of making a special cabinet and dials such as were used in this receiver, so it may be said here that these materials have no effect on the set itself. Therefore, we will forget that this unusual receiver was housed in an unusual cabinet, and will consider the other mechanical and the electrical details.

Possibly the very best panel to use for this particular receiver is that recommended by the manufacturer of the parts, namely a copper, brass or aluminum panel suitably drilled. A standard wooden cabinet of any desired design may be employed.

Reference to the complete circuit diagram in Fig. 2 will make plain most of the details of the receiver. Specially designed and constructed plug-in coils are used. The antenna coil used for tuning the first stage of radio frequency amplification has a tapped primary. This is connected to a two point switch, the blade of which is connected to the antenna. By means of this switch, the set can be adapted to use with a long or short antenna. Nor is the manipulation of this particular part confined only to this purpose. It is often found, in tuning, that selectivity can be sharpened and volume improved by throwing the switch from one point to the other. This particular unit is the one seen in the lower left hand corner of the panel in Fig. 1.

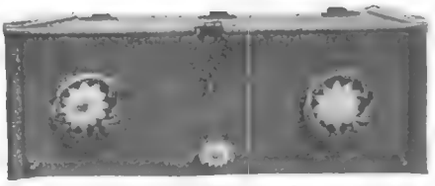


Fig. 1. This photo shows the fine appearance of the panel and hand-carved dials which attracted a great deal of attention at the show.

Due to the necessity of very careful design and construction of the coils used in this set, no winding data is given. Because three of the variable condensers are actuated by one control, a slight variation of the characteristics of one of the coils will mean that the tuning will not be right. Therefore, machine-made manufactured coils are to be preferred and recommended. For the benefit of the readers who are not sure as to where the coils and other parts can be bought, we will mail a complete list of parts on request by letter to the Radio Editor.

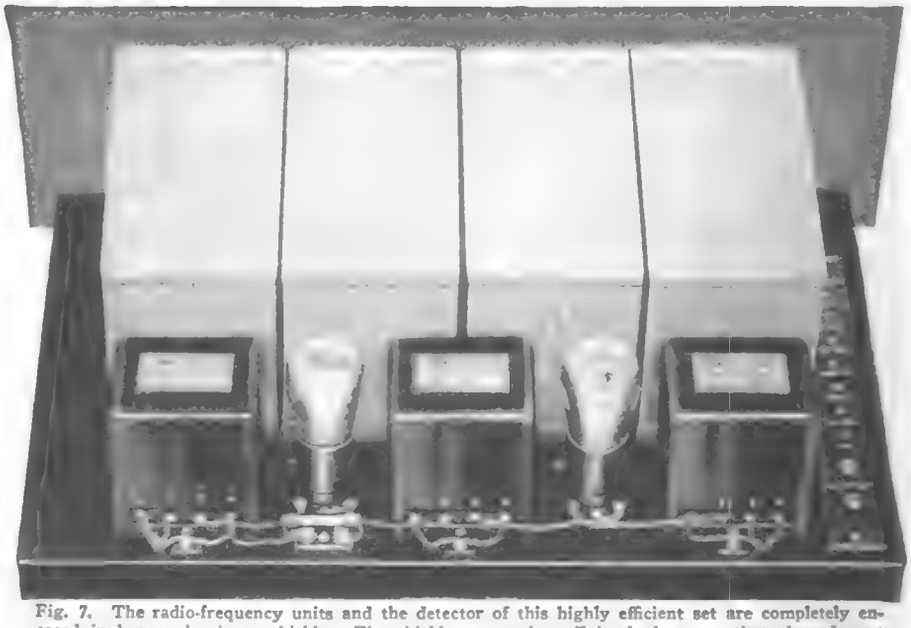


Fig. 7. The radio-frequency units and the detector of this highly efficient set are completely encased in heavy aluminum shields. The shields are made sufficiently large so that they do not broaden tuning by altering the fields of the radio-frequency coils.

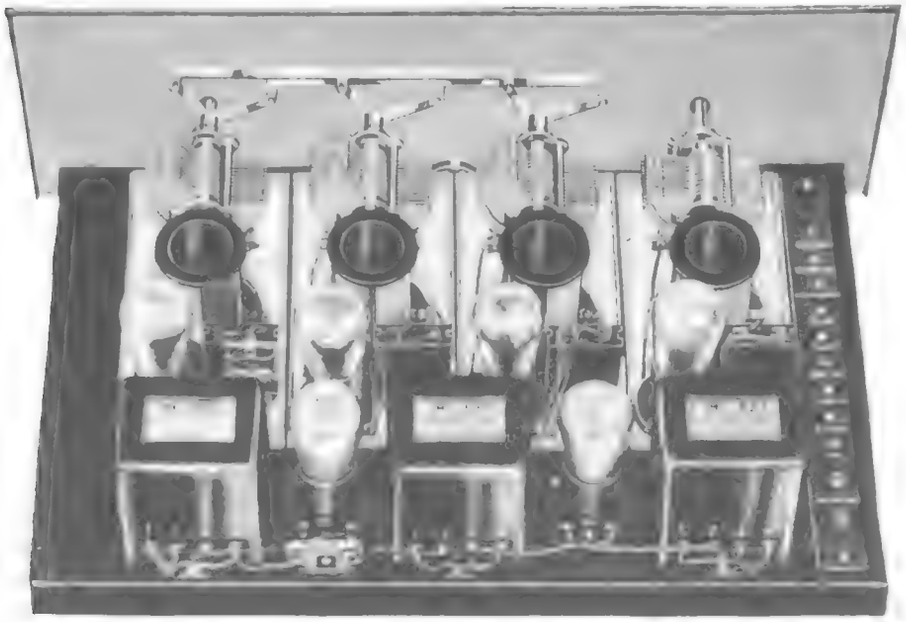


Fig. 6. When the shields are removed, it is seen that the units are neatly and efficiently arranged. The yoke coupling three of the tuning condensers may be easily discerned in this photo.

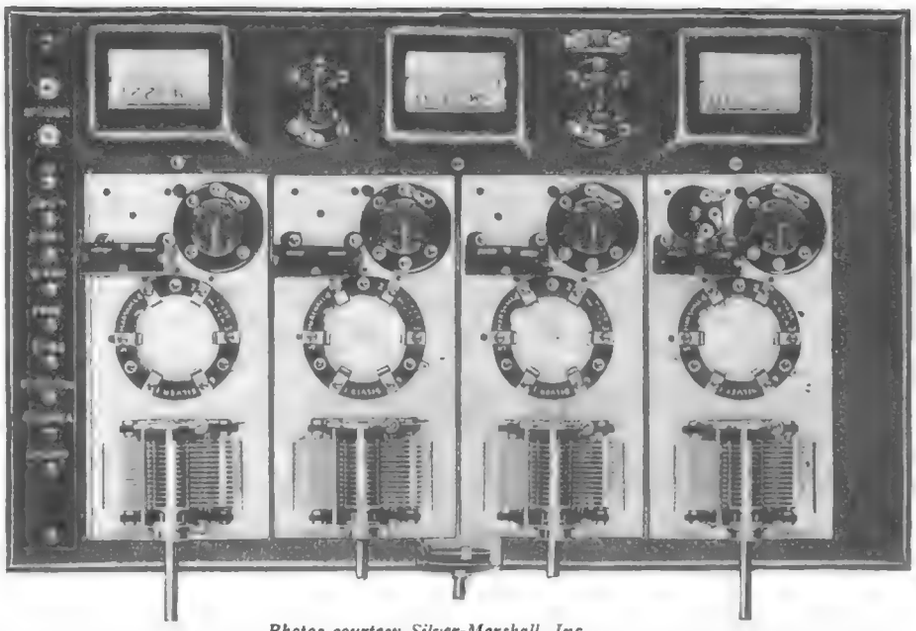
Referring again to the circuit given in Fig. 2, we note that the shields which completely enclose the various stages of radio frequency amplification and the detector are indicated by dotted lines. Also be very careful to note that certain connections terminate at the shields. These shields are furthermore all connected together, and therefore may be considered as a continuous conductor. The negative filament circuits are grounded at various points, in this way continuous connection being made between the negative "A" battery and the ground. Note that the connection from the ground binding post is merely made to the shield. The other shield connections complete the circuit.

All of the coils employed in this receiver have three windings. In the case of the detector circuit, one of these windings is not employed. There is, on the other hand, a small radio frequency choke coil of standard construction connected in the plate circuit of the detector tube.

In the three radio frequency amplifiers, a coil closely coupled to the grid circuit is connected in series with the plate circuit.

This is used to obtain an additional amplifying value, and when the coils are properly designed and connected, exceptional results are noted with this form of apparatus. It will be noted that the radio frequency amplifiers are stabilized by means of grid resistances and further by means of a 25,000-ohm potentiometer connected in the plate circuit of the first radio-frequency tube. Also, rather large by-pass condensers are connected from the shields to the positive "B" battery terminals. These are of great value in stabilizing the set and keeping it in a stable operating condition. Failure to include these condensers will result in poor reception.

Without a doubt, today is the era of standardization in radio material. There is no longer any need of searching from store to store in order to find certain parts. Kits supply everything. All of the parts for this particular receiver under discussion can be obtained very readily. Furthermore, it is no longer necessary for you to construct a base board and fasten all the parts to it. A complete metal chassis can be obtained and all of the instruments bolted thereto. This metal chassis simplifies construction to an enormous degree, and enables even the veriest tyro to turn out a receiver which will compare favorably with the very best of manufactured sets.



Photos courtesy Silver-Marshall, Inc.

Fig. 4. A bird's-eye view of the baseboard with tuning coils and tubes removed from their sockets. The wiring is carefully placed out of the way under the base. Panel and cabinet are not essential.

The simplicity of the entire lay-out will become noticeable at once by reference to the various photographs in Figs. 3 to 7, inclusive. Fig. 5 again shows the novel cabinet employed by Mr. Brams in the construction of the original receiver, and shows how the complete set, assembled on the metal chassis, fits within the cabinet. It will be noted that everything is extremely compact and strong both mechanically and electrically.

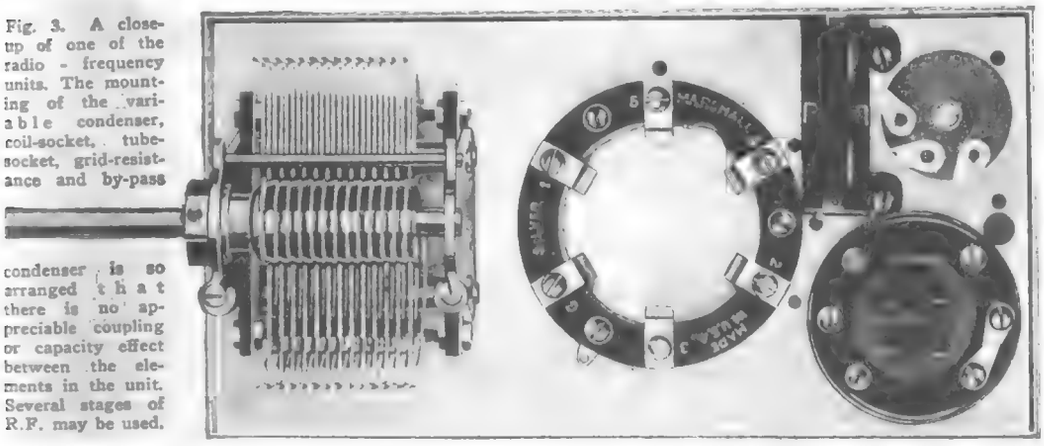


Fig. 3. A close-up of one of the radio - frequency units. The mounting of the variable condenser, coil-socket, tube-socket, grid-resistance and by-pass condenser is so arranged that there is no appreciable coupling or capacity effect between the elements in the unit. Several stages of R.F. may be used.

Fig. 3 shows a single one of the shielded units with the outside "can" or over-all shield removed. The particular unit illustrated is that used for the detector. The circular object in the corner nearest to the vacuum tube socket is the choke coil, mounted on end. Next to it is a fixed condenser of 1-mf capacity, and next to this is the special socket designed for receiving the plug-in coil. At the extreme end of the metal base is mounted the variable condenser.

Referring to the photograph shown in Fig. 4, we find a view of all of the parts. They are laid out on the metal chassis and are bolted down, but have not yet been wired. A special terminal strip mounted at the left end of the chassis provides for all terminals. Two cord-tip jacks are included for loud speaker.

Fig. 6 shows yoke making it possible to operate three of the four variable condensers with a single control. As will be seen, this yoke is fastened to the shafts of three of the condensers. Two of these have short shafts which do not project through the panel. The third one, on the extreme left in the photograph, has a long shaft which projects through a collar in the yoke and through the panel. One of the tuning dials is fastened to the outer end of this shaft. The other is mounted on the right hand condenser which also has a long shaft, but which is not fastened to

(*Continued on page* 743)

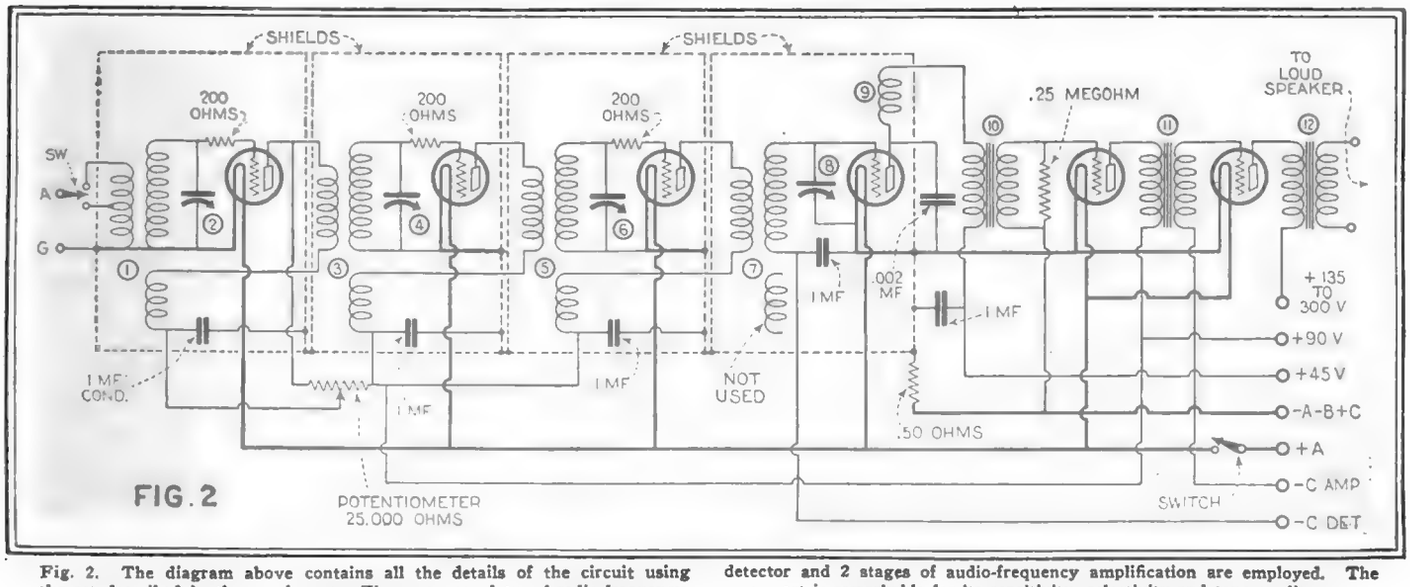


FIG. 2

Fig. 2. The diagram above contains all the details of the circuit using the set described in these columns. Three stages of tuned-radio-frequency, detector and 2 stages of audio-frequency amplification are employed. The set is remarkable for its sensitivity, selectivity and tone quality.

Sir Oliver Lodge's "N" Circuit

Latest Circuit Gives Extreme Selectivity, Sensitivity and Volume

By JAMES FRANCIS CLEMENGER

CONSIDERABLE interest has been aroused in all classes of British amateurs by the announcement of a new invention by the oldest and most famous of British radio pioneers, Sir Oliver Lodge, F.R.S. Sir Oliver's invention, which has been temporarily named the "N" Circuit, has now been taken up for commercialization by a well-known British radio firm, and a few weeks ago the first commercial models of two-valve and three-valve "N" circuit receivers were on view to the public at the British Radio Exhibition at Olympia. Public demonstrations have been given and the press have been invited to attend demonstrations, and all the newspapers in the country have remarked in highly favorable terms on the "N" circuit. So much so, in fact, that I understand that large orders have already been placed by dealers "on the other side" who realize that the "N" circuit is a type of receiver which will make a tremendous appeal to the ordinary listener. And the reason for all this great interest is that Sir Oliver Lodge has devised a circuit which does away with the bugbear of oscillation.

My American readers do not need telling that there is nothing new in doing away with oscillation and howling in a receiving set, but I think they will agree with me that such sets, which do away with these bugbears, are generally multi-tube receivers, and that when regeneration is cut out of a tube set the loss in volume has to be made up in extra tubes for amplification.

And furthermore, such receivers are, as a rule, not exactly easy for the absolute novice to control. One of the great points about the Lodge "N" circuit receiver is its simplicity. On the commercial sets which I have inspected there is one tuning condenser and one switch for turning on the filament. That is all. And this simplified receiver will undoubtedly make a very great appeal to listeners, not only in this country, but in other countries, who do not like complicated switches and knobs on their radio sets.

Sir Oliver Lodge's invention may be described briefly for the benefit of the technical reader as follows: The invention consists in the use of a free, uncoupled low-resistance oscillatory circuit, capable of very exact tuning, to be stimulated by oscillations from any place where oscillating currents are passing, or where there is an oscillating potential, to work up oscillations of one definite frequency into great amplitude by sympathetic tuning, and to transmit these enhanced oscillations of potential, and no others, to another circuit in which they are utilized; for example, a three-electrode tube or a crystal detector.

According to the patent taken out by Sir Oliver Lodge, an important application of the invention is to receiving apparatus for radio work where it is claimed its use secures high selectivity combined with strong and clear signals, without the use of regeneration and with the exclusion of extraneous noises. The transmission of the enhanced oscillations, continues the patent specification, may be effected by direct connection or by coupling, provided the oscillator is only coupled to a detector which takes so small a current as not to interfere with its free oscillation. It is a transmitter of *alternating potential* rather than of alternating current.

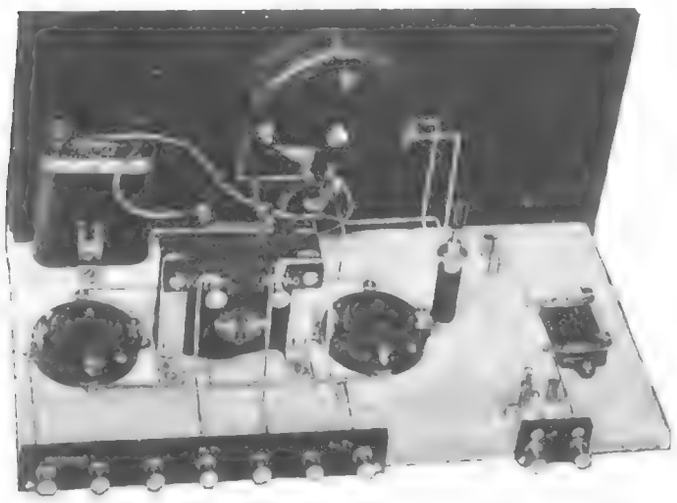


Fig. 5. This photo shows the rear of one of the commercial "QN" circuit sets recently placed on the market by an English firm.

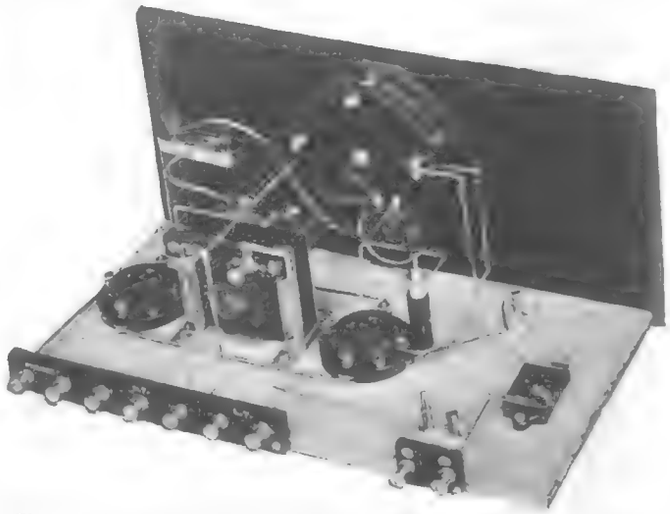


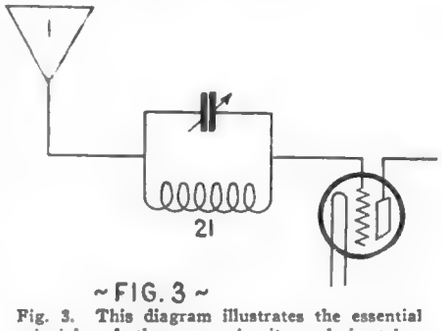
Fig. 6. Another view of the same set showing its extreme simplicity. In both these photos the coils are omitted for clearness.

Through the efforts of our London correspondent, who is in contact with Sir Oliver Lodge, we are enabled to present to our readers the first authorized, accurate description of the famous Lodge "N" circuit to be published in this country. The set illustrated and described here is designed for British conditions, but the information given will be sufficient to give the experimenter a start.

In the January issue of SCIENCE AND INVENTION Mr. Clemenger will present a complete constructional article upon a highly efficient American adaptation of this revolutionary circuit. The most important highlights of this set are:

1. **Simplicity**
2. **Selectivity**
3. **Sensitivity**
4. **Superior signal strength.**

DON'T FORGET: A FULL CONSTRUCTIONAL ARTICLE IN THE ~~JANUARY~~ FEBRUARY ISSUE.—The Editor.



~ FIG. 3 ~

Fig. 3. This diagram illustrates the essential principle of the new circuit, and is taken directly from the letters patent issued to Sir Oliver Lodge. See text for a thorough explanation of the theory.

In Fig. 1 the aerial (1) and inductance (2), condenser (3) and ground (4) represent any ordinary aerial circuit while (5) is the filament, (6) the grid and (7) the plate of any ordinary tube. The filament of the tube is supplied with current from a battery (8) through a resistance (9), while a pair of telephones (10) shunted to a condenser and "B" battery (11) complete the plate circuit. In this diagram a connection is made from the aerial circuit to the grid of the tube and in the usual way through a grid leak and condenser, and in the connection between the aerial circuit and the filament there is inserted the oscillatory circuit "N," which consists of a condenser (12) and inductance (13), one or both of which may be variable. The chief point of the invention lies in the provision of the oscillatory "N", and here it may be stated that it is also possible to insert the oscillatory "N" in the connection to the grid of the tube instead of in the connection to the filament.

But Sir Oliver Lodge points out that this form of the invention must not be confused with the well-known use of so-called rejector circuits.

Fig. 2 shows another well-known form of receiving circuit consisting of a closed oscillatory circuit (15) tuned and coupled to the open aerial circuit. (In the patent it is emphasized that the invention is entirely independent of this part of the system, since it may be supplied to any usual receiving system such as a frame aerial, and even allows the use of an untuned aerial without earth connection).

Fig. 2 shows a diagram with a tube (16) used for high frequency amplification. Its grid and filament are joined across the oscillator (17) which corresponds with the "N" in Fig. 1. One point in this oscillator is joined to a point in the stimulating circuit and the connector used for this purpose may

be quite long provided the capacity between it and neighboring bodies is kept small. This single connection is enough to set up oscillations which build up by resonance, and they must not be disturbed by any other association with the stimulating circuit, as any accidental coupling of the oscillator with the stimulating circuit tends to nullify the effect.

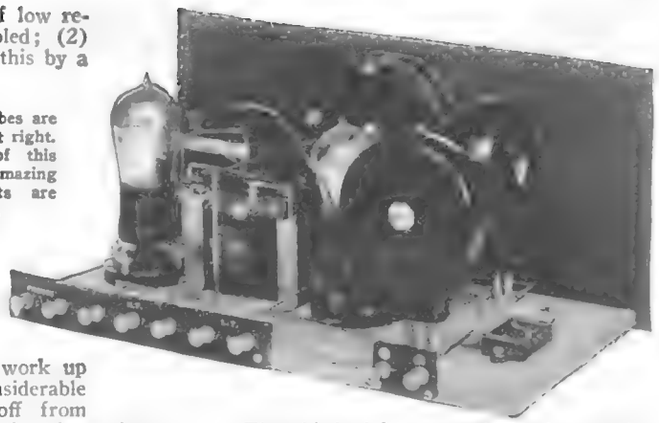
Fig. 2 also illustrates the manner whereby it is possible in this invention to convey impulses from one tube circuit to another. The oscillator (18) which again corresponds with "N" in Fig. 1 has a single connection to the plate circuit of the tube (16). This circuit is shown as including besides a "B" battery an oscillator circuit (19), but other usual methods of plate circuits will do. In order to illustrate the different methods of connecting the oscillator "N," the second tube (20) is shown not connected directly across the oscillator (18) but magnetically coupled with it, the inductance of the oscillator forming one winding of a transformer which may, if it is desired, step up the voltage.

The aerial circuit is merely a means of collecting an alternating potential and conveying it to the oscillator, and it is not necessary to have an accurately tuned aerial circuit nor is it necessary to have a ground connection to any part of the apparatus.

Fig. 3 shows the oscillator (21) connected on the one hand to a single aerial wire which is termed in the Patent Specification a "collector," and on the other hand to the grid of a tube, the plate and filament circuit of which can be wired up in the usual way.

In his final patent, Sir Oliver Lodge sums up the essence of his invention as follows: To have an oscillator of low resistance accurately coupled; (2) to excite oscillations in this by a "collector" or aerial or by a single connection to a stimulating circuit, so as to leave the oscillations free to work up by resonance to a considerable strength; (3) to tap off from this resonance-amplifier the alternating potentials desired for any purpose, such as the working of a crystal or a tube. Furthermore, the working up of a feeble alternating potential to a stronger alternating potential of a constant frequency by the use of a low resistance resonating circuit capable of precise tuning, having only a single connection with the conductor in which the feeble alternations of potential occur. That is the first claim.

The second claim is: In radio receiving apparatus the combination with a tube or crystal detector of a low resistance oscillator circuit, connecting across the grid and filament of the valve or across the detector tuned to the frequency of the oscillations to be amplified or rectified and joined by a single connection to the aerial circuit from which the oscillations are derived.



The coils and tubes are shown in place at right. The simplicity of this set is really amazing when its results are considered.

The third claim—a method of supplying voltage-impulses from a circuit in which oscillations occur to a vacuum tube or to the high resistance detector which consists in placing in the connection between the said circuit and one terminal of the detector, an oscillatory circuit tuned to the frequency of the incoming signal, and not otherwise coupled to the circuit in which the oscillations occur.

And, finally, a method of supplying impulses of a particular frequency collected from space to a vacuum tube which consists in joining to the grid of the tube a low resistance freely oscillating circuit tuned to the incoming frequency, and joining an opposite point of the said oscillatory circuit to a collector or aerial with no ground.

While I have not given the precise constants for the construction of any of the circuits involving the new invention, the experimenter will find it easy to try the circuit out by using standard values of inductance and capacity, as each oscillatory circuit has approximately the same constants as those of the secondary circuit of the usual regenerative receiver.

Fig. 4 shows the hook-up of a British-made two-valve "N" circuit receiver. This receiver has only one main control for tuning, and that is the variable condenser shown in the actual "N" circuit. The coil "A" is wound with fifty-five turns of insulated wire, this being sufficient to cover the British broadcast wavelength band of 300 to 500 meters, while the "N" circuit coil has one hundred and twenty-five turns. The latter coil is tuned by a parallel variable condenser with a capacity of .0001-mfd., and I have found in actual test with this receiver that extraordinarily selective tuning can be obtained. The fixed condensers shown across the primary of the audio-frequency transformer winding have been specially fitted to the commercial Lodge "N" sets in order to switch from the ordinary British broadcast wavelength bands of 300 to 500 meters to the 1,600-meter wavelength of the high-power sta-

(*Continued on page* 745)

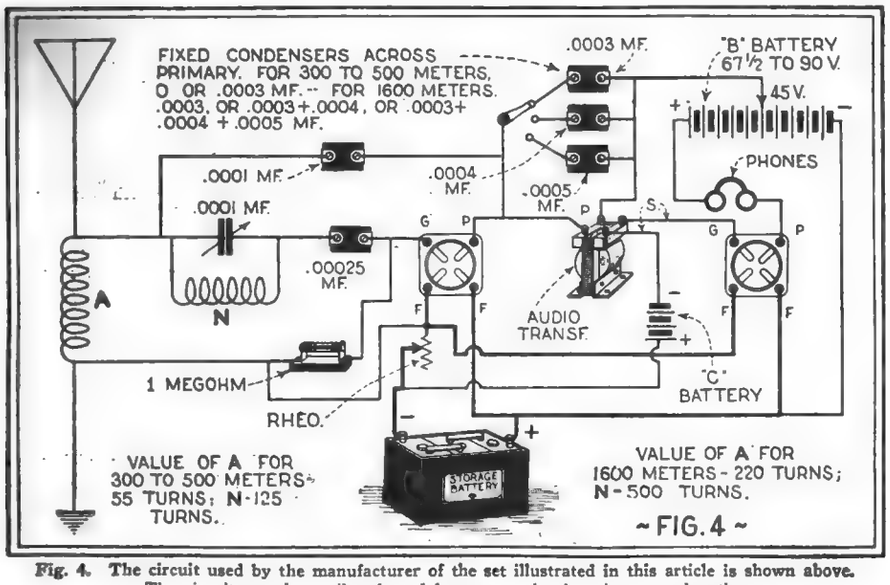


Fig. 4. The circuit used by the manufacturer of the set illustrated in this article is shown above. The circuit may be easily adapted for use on the American wavelengths.

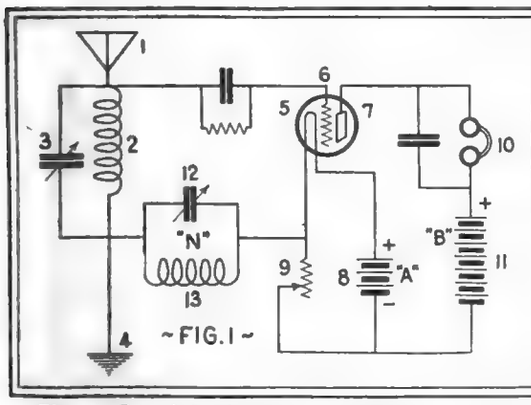


Fig. 1. One of the simplest circuits using the new principle is shown by the diagram of the 1-tube set shown above and explained in the article.

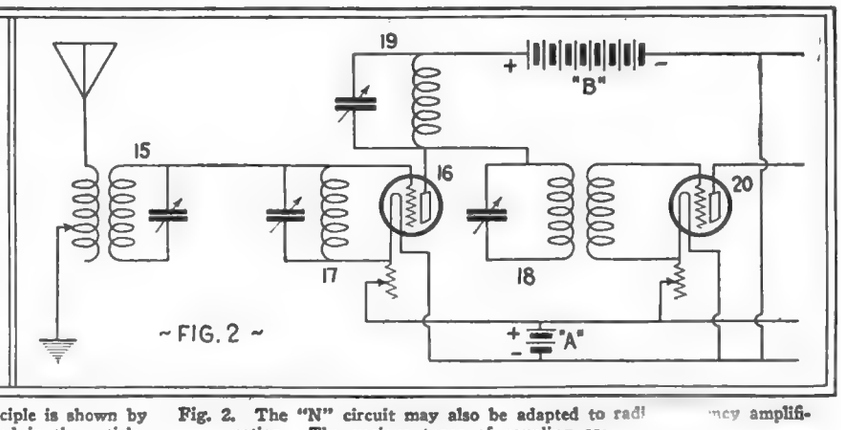


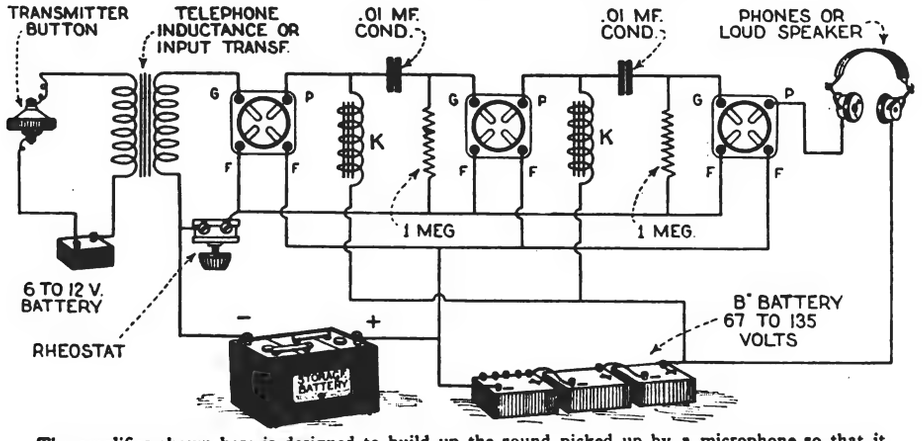
Fig. 2. The "N" circuit may also be adapted to radi ncy amplification. The various types of coupling are

RADIO ORACLE

In this Department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this department cannot be answered free. A charge of 50c. is made for all questions where a personal answer is desired.

EFFICIENT VOICE AMPLIFIER

(513) Q. 1. G. Dusson, Cincinnati, Ohio, wants to know how to amplify the sound picked up by a Skinderviken or similar microphone transmitter button.



The amplifier shown here is designed to build up the sound picked up by a microphone so that it will operate a loud speaker. Impedance coupling is used to reduce distortion, and the amplification obtained is about equivalent to two stages of transformer-coupled amplification.

A. 1. The diagram given here has been found very effective for all types of amplification at voice frequencies, particularly in the case being considered, where the current to be amplified originates in a microphone circuit. The amplification is sufficiently great to make it possible to use the apparatus in many interesting experiments.

MULTI-TUBE NEUTRODYNES

(514) Q. 1. John C. Hays, Indianapolis, Ind., asks: Why is it that a neutrodyne with five stages of radio-frequency amplification has not been put on the market? Would such a set be a success?

A. 1. We consider your inquiry very interesting. Sets having more than four stages of radio-frequency amplification are available, but there are no neutrodynes among the lot. Some of the points are:

1. Two stages require three dials; five stages, at that rate, would necessitate six dials! Take too much time to tune. One-dial controls are easy, in the laboratory. When it comes to commercial production, we have "an equine of a differing hue." A two-dial arrangement might prove practical, after a great deal of experimentation, but there would be plenty of work before the set was ready for the public. It takes a mighty good one-dial set, where the one dial operates two controls, to equal a 2-dial set where each dial has but one control.

2. Some current supply units will work well with five tubes but poorly with eight. The eighth tube also means added expense (the tube price) and battery consumption (if batteries are used) would be more.

3. Tube noises would be more pronounced. Detector tube would often be overloaded, resulting in distortion. Audio amplifier would have to be a wonder to be really efficient, if the set were to include two stages of audio, for both tubes and transformers would have a terrific load when locals were operating.

4. If set is made on low-loss lines, one would have to put a "ring door-bell" sign out, and hope the signals could read, for the selectivity would be so high that it would take considerable time to tune in wanted signals originating at a distance of more than, say, 150 miles. Anyone who has tuned a neutrodyne can appreciate this.

5. Every stage requires neutralization. This is more or less easy to do at home, given all the time, knowledge and patience necessary for success. But to do this rapidly and certainly in production is an entirely different matter. Then again, a set balanced in the factory test-rooms would not necessarily be balanced (neutralized) when entirely different tubes and batteries are used by the broadcast listener.

6. There is the amount to be added to the purchase price of the set, due to several additional production costs. Considering everything, there would probably be a sale for a set having five stages of radio-frequency amplification, neutralized, if the above stated objections were overcome. The most important points we should say, would be (a) to keep down the number of tuning controls and (b) to have a resulting efficiency greater than could be secured by the use of a lesser number of tubes.

TRANSFORMER AND CHOKE DESIGN

(515) Q. 1. Mr. Edwin Thompson of Wichita, Kansas, asks for the dimensions of form and winding required for B-battery eliminator, transformers and filter chokes.

A. 1. The following dimensions are furnished us by the manufacturers of the Raytheon tube.

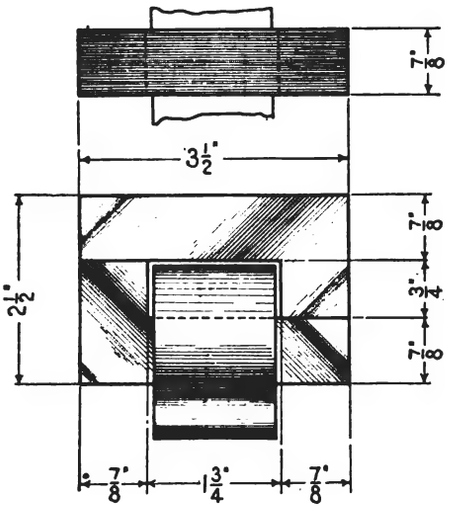
Transformer core 7/8 square, as shown here.

Primary 1140 turns No. 28 enamelled copper wire. Tap at 910 turns.

Secondary 4200 turns No. 31 enamelled copper wire. Tap at center.

Wound in layers with .0015″ paper between layers.

Electrostatic shield between primary and secondary (.005″ copper).



The form above is that recommended by the manufacturers of the Raytheon tube for chokes and transformers in their "B" eliminator circuit.

Core material is Apollo special electrical steel No. 29 gauge. Laminations are assembled to give staggered air gaps.

Primary d.c. resistance is approximately 25 ohms.

Secondary d.c. resistance is approximately 300 ohms, total.

Two halves of secondary should be balanced for voltage output at full load output within two per cent.

Choke Coils—Core 7/8″ square, same design. 5800 turns No. 28 enamelled copper wire on each coil.

D.C. resistance of each coil is approximately 190 ohms.

Laminations are assembled to form a butt joint, with .003″ insulated air gap.

BROADCASTING STUDIOS

(516) Q. 1. Fred T. Barton of Chillicothe, Ohio, asks: Please describe the construction of a modern broadcast station studio.

A. 1. The walls may be constructed of gypsum block. Over this is placed a layer of lith. This is a sound absorbing material. It is also applied to the ceiling. A triple wall construction should be used. Between the walls a thick layer of sound-deadening material is laid. The furniture should be wood-doweled, not nailed.

Q. 2. Should draperies be used to prevent echoes?

A. 2. A certain amount of reverberation is required. By use of a partial drapery, the correct balance between reverberation and a total absence of echo may be easily obtained. If the special wall construction described above is used, no drapery is required.

Q. 3. What is the difference between reverberation and echo?

A. 3. Reverberation is a type of echo so closely spaced to the original sound that the separation cannot be detected by the ear. An echo is so timed that the separation can be readily detected.

DIFFICULTIES IN TRANSMISSION

(517) Q. 1. Miss Nancy MacDonald, New York, N. Y., asks: What are the difficulties in transmission of radio signals which cause varying ranges of reception, etc.?

A. 1. There are three principal sources of trouble encountered in practice which make it difficult to receive readable radio signals: (1) Interference from transmitting stations whose signals it is not desired to receive. (2) strays or static, and (3) the "fading" of the strength of the received signal.

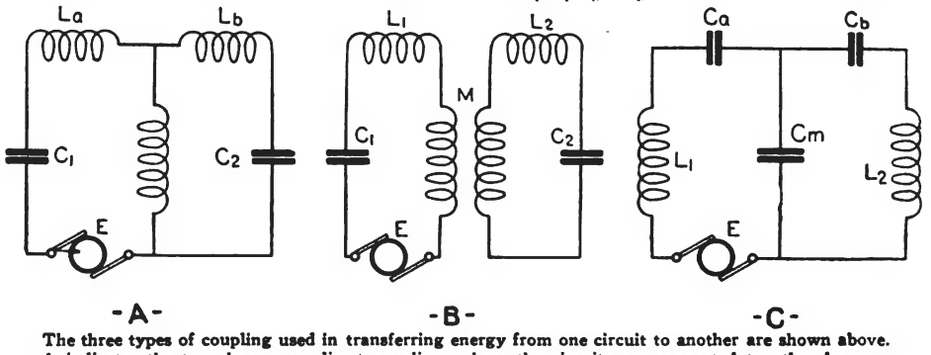
Interference from other transmitting stations can to a large extent be eliminated by selection of frequency (wavelength), particularly by the use of transmitting apparatus which will radiate only a single wavelength or a narrow band of wavelengths. Laws have been enacted which are designed to minimize interference from other stations.

Strays are electrical disturbances giving rise to irregular interfering noises heard in the telephone receivers. They are also called "static," "atmospherics," "X's," and other names. In any particular case the possibility of getting a readable signal depends on the ratio of the strength of the signal to the strength of the static at that time. Experienced operators have stated that it is possible to copy messages when the strays were four times as strong as the signals but much difficulty is often experienced even when the strays are much weaker than this. The most common type of stray produces a grinding noise in the telephones; this type causes the most serious trouble. Another type, which produces a hissing noise, is usually associated with snow or rain. Near-by lightning produces a sharp snap.

TYPES OF COUPLING

(518) Q. 1. F. White, Baltimore, Md., asks how the current in the primary circuit of a radio set gets to the secondary circuit.

A. 1. There are three methods by which a change in voltage in one circuit may be made to cause a corresponding change in another circuit coupled to it. The three methods are shown in the accompanying diagram.



The three types of coupling used in transferring energy from one circuit to another are shown above. A indicates the type known as direct coupling, where the circuits are connected together by conductors. B illustrates inductive coupling, while C represents capacitative coupling.

Scientific Humor

AN ESSENTIAL COMPOUND

"Why," said the philosopher, "is chemistry necessary in your joke-writing profession?"

"Because," answered the humorist, "it is necessary that I study the silicide of life."—*E. A. Daansen.*

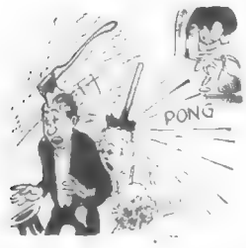
(And some think Petruchio's wife was a silicate (Silly Kate).

PERHAPS A YOUNG EINSTEIN

"I understand your boy Josh, is interested in perpetual motion."

"Yes," replied Farmer Sawbuck, "and I'm kinder encouraged by it. I thought for a while that the only thing he was interested in was perpetual rest."—*L. J. Schario.*

A (C)RUSTY TRICK



Hammers and hatchets will never rust if kept covered in rice. Care must be taken, of course, to remove the tools if the rice is to be used for wedding purposes. — *Jos. Malnikof.*

WE NEVER THOUGHT OF IT THAT WAY

Professor in physics class: "Johnny, why is it that everything that I tell you goes in one ear and out the other?"

"I didn't know it did, sir."

Voice in back of room: "That's right; it doesn't. Sound can't pass through a vacuum!"—*Earl Floathe.*

GASOLINE VS. GAS

GASOLINE VENDER (to dissatisfied customer): "This gasoline is of the highest quality. It is made by the cracking of hydrocarbons."

CUSTOMER: "I can't help it if it is. It isn't what it's cracked up to be."—*Donald A. Cuthbert.*

YES, HE DID!

A spinster living in a growing suburb was shocked at the language used by workmen repairing telegraph wires close to her house. She wrote to the company, and the foreman was asked to report. This he did in the following way:

"Me and Bill Fairweather were on this job. I was up the telegraph pole and accidentally let the hot lead fall upon Bill. It went down his neck. Then he said: 'You really must be more careful, Harry.'"—*Leonard Keiser, Jr., Rep. No. 27612.*

First Prize $3.00
THE FOURTH DIMENSION

Science points out that the lesser cannot contain the greater, but science evidently knows little about a woman's shoe. —*Louise Krauss.*

WHAT IT IS (OR WHAT IT ISN'T)

One day in school the teacher said:

"Mickey," give me a definition of salt."

"Shure," Mickey responded. "It's the stuff that makes potatoes taste bad when you boil 'em and don't put any in."—*Carl C. Slaybough*

WE receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. We cannot return unaccepted jokes. Please do not enclose return postage.

All jokes published here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to tie for the prize, then the sum of three dollars in cash will be paid to each one.

DOUGH! DOUGH!

FATHER: "Your talk is just like the musical scale."

DAUGHTER: "Musical scale?"

FATHER: "Yes, you begin with dough, and you end with dough." — *Booth Mooney.*

THE LUNACY OF LOVERS

TEACHER (in science class): Can anyone of you tell me how the moon affects the tide?"

A girl in back part of the room raised her hand and said, "No, it doesn't affect the tied much, but it affects the untied a great deal."—*John Kozik.*

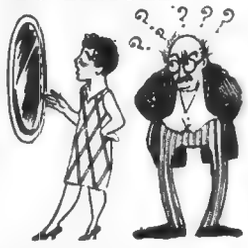
INDEED IGNORANT!

"We are getting wiser each generation. I am wiser than my father was and he was wiser than his father."

"I dare say your grandfather must have been ignorant!"—*Adela Tomfohr.*

A SIGHT TO BEHOLD

PROF: "Why are you standing before the mirror with your eyes closed "



GIRL STUDENT: "To see how I look when I'm asleep." —*Wilbur Gager.*

NOT THEIR DIET!

SUNDAY SCHOOL TEACHER: "Tommy can you tell me why it was that the lions didn't eat Daniel?"

TOMMY: "Cause most of him was grit and the rest backbone!"—*Henry A. Courtney.*

AN IMPROVEMENT ON RADIO

"You should come over to our house, Ed. Our new howler runs without batteries, neither has it aerial or ground. The mere point of a pin will start it. If you want to hear howly music some night, bring your wife."

"Wonderful . . . I will. But where do you get a radio of that sort?"

"Radio be d——! It's a boy."—*J. Leo Vanderheyden.*

A DIZZY JOB

FIRST RADIO FAN: "Come on and tune in this set."

SECOND DITTO: "Can't. I'm too dizzy from reading a circular letter." —*Clifton Ask, Lanesboro, Minn.*

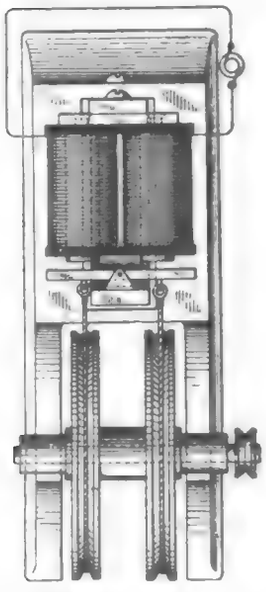
HELLO!

Perhaps the reason why radio listeners in the United States have difficulty in hearing the principal broadcast station in London, England, is because it is 2 L. O. (too low). —*Webb Buckley.*

MEET SIMON, OUR AMATEUR SCIENTIST! HE LEARNS A LESSON IN SCIENCE EVERY DAY
HOW DO FOLKS!
JUST IN TIME TO WATCH ME BORE A HOLE THROUGH THIS RADIO PANEL WITHOUT A DRILL---
--- ALL YOU NEED IS AN IRON ROD, A NICE HOT GAS FLAME -- AND THEN ---
WOW!
SCIENCE LESSON NO. 1
ALL METALS ARE VERY GOOD CONDUCTORS OF HEAT. ON THE OTHER HAND SUBSTANCES LIKE WOOD, CORK AND ASBESTOS ARE POOR CONDUCTORS. FOR THAT REASON THE HANDLES OF ELECTRIC IRONS, STOVE-POKERS AND TEA KETTLES ARE MADE OF WOOD.
YESSIR! A 5/8 INCH HOLE RIGHT ON THAT SPOT!
W. LEMKIN

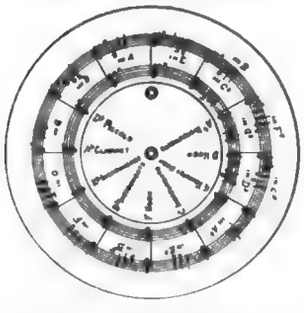
LATEST PATENTS

WHIP MOTOR



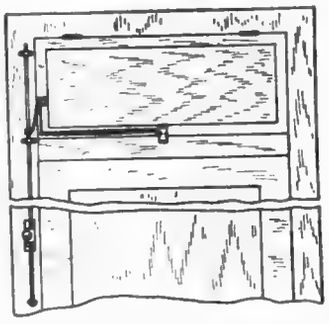
No. 1,587,665 issued to Fritz P. Mansbendel. This patent covers an improvement on a very interesting but little known machine. It is an alternating current motor operating on the principle of the whip top. The power developed is much greater than that of the usual type of small motor.

TRANSPOSITION CHART



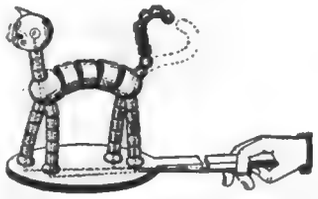
No. 1,692,204 issued to Aime Pollefeyt. Arrangers are constantly faced with difficulty in making orchestrations, arising from the fact that practically every instrument requires music written in a different key. This device is designed to eliminate much of the labor involved by providing a direct reading method of transposition. The chart may be adjusted to transpose from any key into any other. The device should also be useful in arranging vocal scores, where different parts must be combined.

TRANSOM LOCK



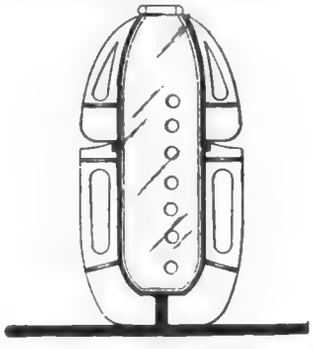
Issued to Jos. S. Hayworth. A useful improvement in door-fittings, which is designed to cause the transom to be firmly locked against entry when it is closed, and to be automatically released when it is desired to be opened.

AMUSING TOY



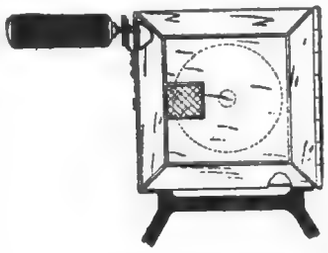
No. 1,601,983 issued to Edward S. Savage. Flexible cords running through the blocks forming this toy permit amusing gyrations to be performed. The toy is operated as seen above.

MILK BOTTLE PROTECTOR



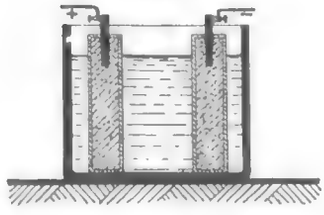
No. 1,601,888 issued to Americo Sico. This patent covers a protective envelope, made of sponge rubber, which is to be used as a cover for baby's milk bottle. The sponge rubber is very resilient and should prevent breakage due to the bottle dropping to the floor. The same principle may be applied to any other type of glass container.

EXTINGUISHES FILM FIRE



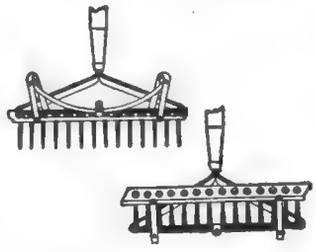
No. 1,589,514 issued to Walter S. Josephson. Practically all the destructive fires in motion-picture theatres occur as the result of the ignition of highly inflammable celluloid film contained in the projector magazines. In this case a fire extinguisher containing a non-combustible gas at high pressure is attached to the magazine so that it may release the gas, thus extinguishing the fire at the first sign of danger.

STORAGE BATTERY IMPROVEMENT



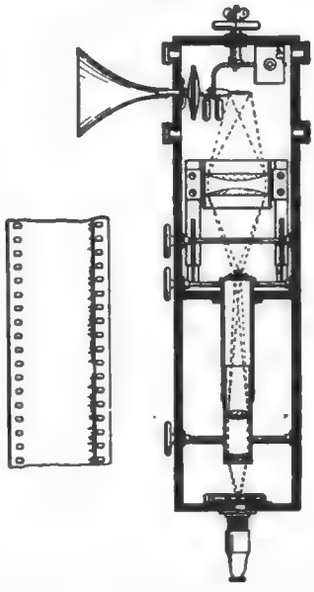
No. 1,588,608 issued to Rene Oppenheim. An improvement in storage battery design, in which the electrodes are suspended in a solution of ammonium chloride in porous cups.

SELF CLEANING RAKE



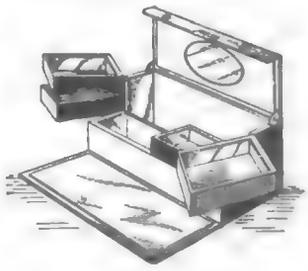
No. 1,595,556 issued to Edmond Laurencelle. A simple and extremely ingenious attachment for the usual garden rake, which makes it possible to remove debris adhering thereto by reversing the teeth and pressing the back of the rake to the ground.

PHOTOGRAPHIC SOUND RECORDER



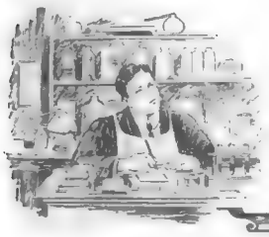
No. 1,588,884 issued to Russel Hart. A method of recording sound upon a motion picture film which employs the well-known principle of the manometric flame. The flame is controlled by the sound waves, and its image is recorded at the edge of a standard cinema film. The reproducing device is essentially similar, using the light-sensitive cell to change the record back into sound-waves.

COMPLETE VANITY CASE

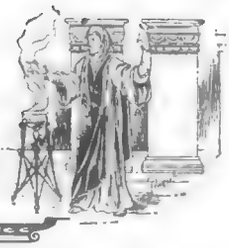


No. 1,600,830 issued to Florence N. Lewis. Vanity cases seem to be approaching more and more the size and completeness of professional make-up boxes. This one contains a space for everything, but is still small enough to be easily portable. The swinging drawer arrangement permits a large variety of contents without causing them to be badly mixed together. A mirror is of course provided, also a space for change, stamps, etc.

NOTICE TO READERS. The above illustrated and described devices have recently been issued patent protection but are not as yet to our knowledge available on the market. We regret to advise that it is impossible to supply the names and addresses of inventors of the above devices to any of our readers. The only records available, and they are at the Patent Office at Washington, D. C., give only the addresses of the inventors at the time of application for a patent. Many months have elapsed since that time, and those records are necessarily inaccurate. Therefore, kindly do not request such information. —EDITOR.



THE ORACLE

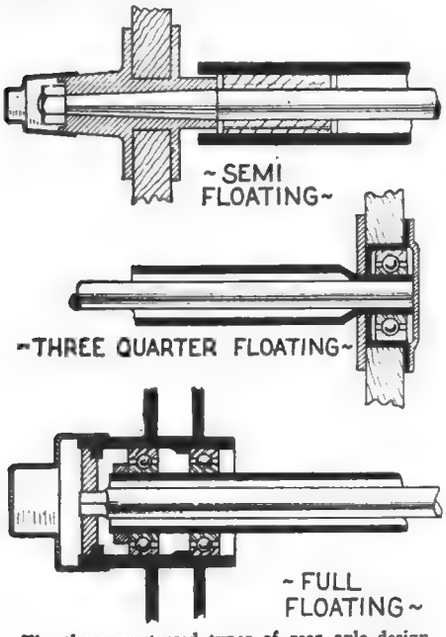


The "Oracle" is for the sole benefit of all scientific students. Questions will be answered here for the benefit of all but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink; no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 50 cents is made for each question. If the questions entail considerable research work or intricate calculations, a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

TYPES OF REAR AXLES

(2143) Q. 1. Mr. Edward Tyson, Birmingham, Ala., asks us to differentiate between the types of automobile rear axles.



The three most-used types of rear axle design used in motor car construction are illustrated in these three cross-sections.

A. 1. Referring to the accompanying descriptions, you will see the three common types of rear axles illustrated. The difference between the "full-floating," "semi-floating," and "Three-quarter floating" axle is given by The Timken-Detroit Axle Co., as follows:

In the "full-floating" type of axle, all the bending stress due to static force and skidding force is carried by the housing. The driving shafts turn freely within the housing and bear only the "torque" or stress of turning the wheels. The shafts are said to "float" within the housing. The axle is not a full-floating type if the wheel is keyed to the shaft.

In the full-floating axle the shafts can be more easily removed for repairs. This is an advantage. It is necessary to make the full-floating somewhat heavier than the fixed-hub type for the same capacity.

In the "semi-floating" type, more properly called the "fixed-hub" type, the driving shafts turn freely within the housing. At their outer ends they are fixed in the hubs of the wheels and carry the bending stresses as well as the torque. The hub of the wheel is fitted to the shaft with Woodruff keys and a nut which serve to secure the wheel to the shaft. The hub cap is merely a protection to the end of the hub.

In the "three-quarter floating" type or, better, the "flanged-shaft" type, the housing extends into the hubs of the wheels as in the "full-floating" type, but the ends of the driving shafts are connected rigidly by flanges with the wheels so that the shafts take almost all the bending stresses and all the torque. In the flanged-shaft axle, especially when only one bearing is used under the center of the wheel, the stresses are quite similar to those in the fixed-hub type.

ARC WELDING TRANSFORMER

(2144) Q. I. W. D. Bohon, Rupert, Idaho, asks for data on the standard type of arc welding transformer and on the best type of torch to use with the transformer.

A. 1. The data for the construction of an arc welding transformer is as follows: The core is built up of strips of silicon steel, .014 inches thick into the form of a rectangular frame, 15 inches long by 7½ inches wide in outside dimensions. The legs are to be 2 inches square. The primary is wound with 13½ pounds or 344 turns of No. 10 D.C.C. wire. The secondary consists of 31 turns of No 0 D.C.C. wire. Carbon electrodes are to be used with this transformer.

REPORTER

Science and Invention

CORRESPONDENT REPORTER'S IDENTIFICATION

NO. 10000

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FINDING BURIED TREASURE

(2145) Q. 1. Bill Cothrum, Dallas, Texas, asks if we know of any system of locating buried metals by electricity or radio.

A. 1. In our issue of March, 1926, we described all the common methods used for the purpose you specify in your question. More or less success has been obtained in the location of ore bodies by these methods, but the detection of buried treasure is very much like looking for a needle in the haystack, as the old saying has it. In our issue for August, 1921, the Hughes Induction Balance is described. Both of these issues may interest you.

UNINFLAMMABLE CELLULOID

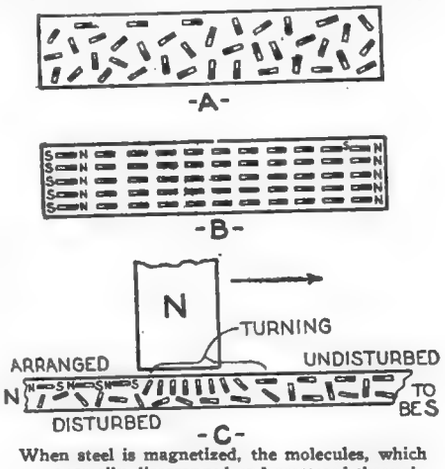
(2146) Q. 1. Mr. Jos. Leland, Wilmington, Ohio, desires a method for the preparation of uninflammable celluloid.

A. 1. The operation of this process as prescribed by Woodward is the following: In a receiver of glass or porcelain, liquefied fish glue and gum arabic are introduced and allowed to swell for 24 hours in a very dry position, allowing the air to circulate freely. The receiver is not covered. Afterwards it is heated on a water bath, and the contents stirred (for example, by means of a porcelain spatula) until the gum is completely liquefied. The heating of the mass should not exceed 77° F. Then the gelatin is added in such a way that there are no solid pieces. The receiver is removed from the water bath and colza oil added, while agitating anew. When the mixture is complete it is left to repose for 24 hours. Before cooling, the mixture is passed through a sieve in order to retain the pieces which may not have been dissolved. After swelling, and the dissolution and purification by means of the sieve, it is allowed to rest still in the same position, with access of air. The films formed while cooling may be removed. The treatment of celluloid necessitates employing a solution completely colorless and clear. The celluloid to be treated while it is still in the pasty state should be in a receiver of glass, porcelain, or similar material. The mass containing the fish glue is poured in, drop by drop, while stirring carefully, taking care to pour it in the middle of the celluloid and to increase the surface of contact. When the mixture is complete, the celluloid is ready to be employed and does not produce flame when ignited. The solution of fish glue may be prepared by dissolving in 200 parts of cold distilled water. It is then passed through the sieve, and the pieces which may remain are broken up, in order to mingle them thoroughly with the water. Ten parts of kitchen salt are then added, and the whole mass passed through the sieve. This product may be utilized for the preparation of photographic films or for those used for cinematographs, or for replacing hard caoutchouc for the insulation of electric conductors, and for the preparation of plastic objects.

THE MAKING OF MAGNETS

(2147) Q. 1. Everett Robertson, Tucson, Arizona, asks how magnets are made.

A. 1. To answer this question intelligently, it is necessary to take up something of the theory of magnetism. The facts of magnetism are most easily accounted for by assuming two things:



When steel is magnetized, the molecules, which are normally disarranged and scattered throughout the substance, are caused to "line up."

First, every molecule of a magnetic substance is itself a magnet; second, in an unmagnetized substance, these molecular magnets are pointing in many directions on account of the mutual attraction between their poles (Fig. A.) When the north pole of a magnet is brought near a piece of iron, the molecules swing around, so that their south poles are pointing toward the north pole of the magnet. Magnetizing a body, then, consists in turning the molecular magnets so that similar poles all point in the same direction and remain so. (Fig. B.) At one end of a magnet, north molecular poles will make the outside layer, and this will be a north pole; at the other end, there will be a south pole for a corresponding reason. Throughout the body of the magnet, the attraction for each other between these unlike molecular poles, tends to neutralize the magnetism; in the center portions of the bar it practically is not noticeable. All magnets are made by induction. Two different methods of induction are illustrated in following experiments. Rubbing the N pole of a magnet along a steel bar brings the magnetizing force so close to the molecules in the bar that these molecules turn their S poles in one direction to face the moving N pole of the magnet (Fig. C.) Thus these molecules are left so that the end of the bar last touched by the magnet pole will be a pole opposite in sign to the magnetizing pole. This method, while simple, does not make very strong magnets. The best way of making a magnet is to use an electric current. The steel to be magnetized is placed within a coil of insulated wire and an electric current is passed through the coil. Tapping the steel while the current is passing, aids the molecules to rearrange themselves and results in a stronger magnet. A powerful electromagnet can also be employed. This is the method used in making magnets commercially.

DAMP-PROOFING HOUSE

(2148) Q. 1. Thos. C. Henry of Henderson, Ky., would like to know a good, cheap filling to check drafts and keep out dampness in waintscoting his new home.

A. 1. Concerning damp-proofing of walls which are to be wainscoted, would say that about the only thing to do is to use tar paper over the studding first, and to follow this with newspaper.

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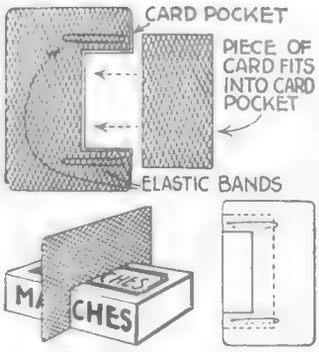
NO. 45 OF A SERIES

Chinese Lantern

A folded Chinese lantern is filled with water after being opened. The magician then plunges his hand into the interior of the lantern and withdraws large quantities of silks, pours out the water and collapses the lantern.

It is apparent from the drawings above that the telescopic Chinese lantern contains a rubber bag affixed to half of the lantern and extending halfway across the top. This serves as the container for the water.

Sawed and Restored Match Box

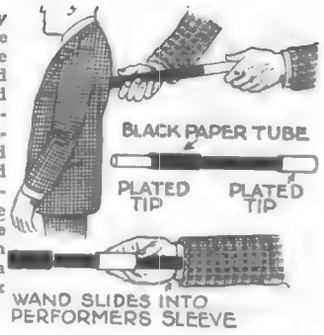


This is an excellent pocket trick. The performer apparently saws a match box in half with a playing card. Upon removing the playing card, the match box is found whole. The match box is unprepared, but the card is not innocent.

It will be observed that the playing card is really made of two cards, partially glued together and so arranged that a pocket is formed between them. Another piece of card fits into the pocket thus formed.

Improved Swallowing Wand

The necessity of holding the hand over the nickel - plated tip of the wand while performing the swallowing wand and kindred stunts is eliminated by the use of this type of construction which uses a sliding black tube.



The first movement of pushing the wand through a spectator's back consists in sliding the black paper tube over the plated tip. From this point only one hand need be used.

Dunninger Versus Science

DUNNINGER, the Master Mind of Modern Mystery, as he is termed, is known to thousands of our readers throughout the nation. Dunninger has for years been our chief magical authority, and Chairman of our Scientific Investigation Committee on Spiritualism. He is perhaps the best known society entertainer in the world, and has mystified hundreds of prominent persons.

Dunninger presents an offering in so-called mind-reading, in which he offers a reward of $10,000.00 to anyone who can prove that he employs assistants or confederates in his work, in any manner or fashion. The editor is frank to admit that he attended one of Dunninger's recent performances, with a view toward discovering the modus operandi employed in Dunninger's work, possibly to collect the $10,000.00 offered. The writer has failed in both attempts. Dunninger tells his audience he is not supernatural, and yet he presents things that are little short of miraculous. At least there seems no scientific explanation for his work. I viewed his act at the B. F. Keith theatre, Boston, one of the theatres in which he was recently a headliner. Ushers legitimately connected with the theatre, passed small slips of paper among the audience. The spectators were requested to write names and questions upon these slips, which they retained in their possession. They were positively not collected. Dunninger, seated upon the stage, in full and brilliant light, called out aloud dozens of these names, many of the questions, called telephone numbers correctly, told people the day, month, and year of their birth, and yet we know there is no such thing as the supernatural . . . and what is more, he admits it . . . yet, how does he do it? We cannot say, and he will not tell.—*The Editor.*

A Temple Buddha Mystery

MIDGET INSIDE OF FIGURE ANSWERS QUESTIONS
FLEXIBLE SWORDS PASS AROUND BODY OF FIGURE THROUGH TUBES
TUBES FASTENED TO FIGURE
TUBE

Here is an original illusion, inexpensive to construct and mystifying to the extreme. An East Indian Buddha is seen sitting on a platform. The figure on the magician's command sings, whistles, speaks and answers whatever question the wizard asks. In order to illustrate that the figure is simply mechanical, the wonder worker proceeds to run a number of sharp edged swords through the body of the Buddha. One of these passes through the neck, two through the chest, one through each leg and one through the stomach. In spite of these the automaton continues his conversation. The secret lies in the fact that a small midget is concealed in the figure which is made of metal. The figure has a mechanical moving face, operated from strings on the inside, similar to that of the ventriloquial figures. Tubes leading around the body, legs and neck permit the swords to pass.

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Free Cathode Rays

By G. C. B. ROWE

(*Continued from page* 691)

heats the filament in the cup-shaped cathode, C. The long tube on the right in which there is an enlargement, is of copper and goes just up to the window, W, as seen in Fig. 5B. This tube serves as a shield to prevent the electrons from striking the glass walls of the anode arm.

The construction of the window is extremely interesting, as it is here that the majority of the difficulties have been encountered. The window itself, i.e., the foil used, must be strong enough to withstand the 15 pounds per square inch pressure of the atmosphere; the smaller the atomic number of the window material, the less will be the hindrance offered to the electrons in their passage through the foil; also it must be possible to make a vacuum-tight joint between it and the glass. The metal which most nearly met all these requirements was nickel. A sheet of this 0.0005 of an inch thick and about 3 inches in diameter, was soldered to a ring of invar, which is an alloy of nickel and steel. Invar was used, because it has approximately the same coefficient of expansion as glass and therefore will expand and contract with the glass of the vacuum tube as it becomes hot and cold. Behind this ring of invar is a honeycomb screen of molybdenum, to support the foil against the atmospheric pressure.

It is necessary to have as high a vacuum within the tube as possible and three vacuum pumps in series are used to exhaust it. From a close inspection of the end of the tube in Fig. 7 the foil window may be seen to be pressed so tightly against the molybdenum honeycomb that there are indentations in the foil. This is entirely due to the pressure of the air outside the tube and the very high vacuum within it.

To eliminate from the tube any gases that might remain in the metal parts of the tube during exhaustion and subsequently escape when the tube is in operation, there is

(*Continued on page* 730)

$5,000 for Perpetual Motion

When SCIENCE AND INVENTION Magazine was still in its infancy, the editors denied the possibility of constructing a perpetual motion machine using those forces of nature as we now know them.

Since that time the editors have received thousands of different designs for perpetual motion devices, and have received hundreds of circular letters soliciting finances for the building of perpetual motion machines.

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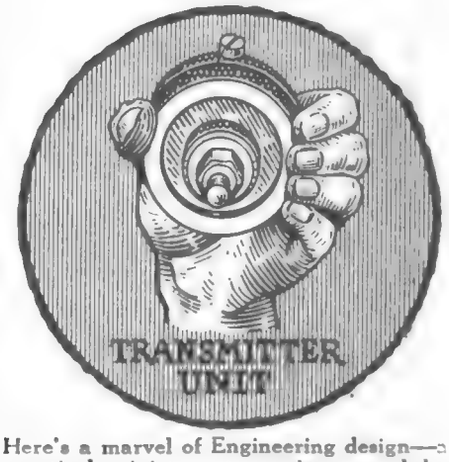

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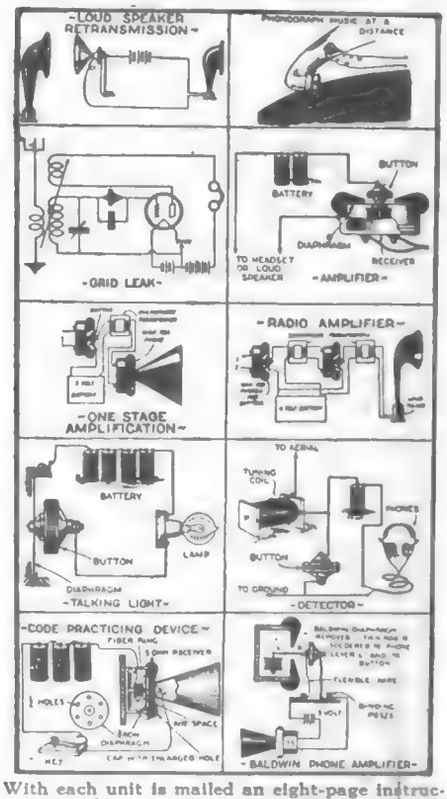

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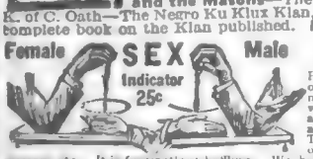

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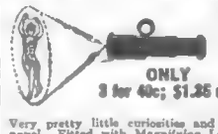

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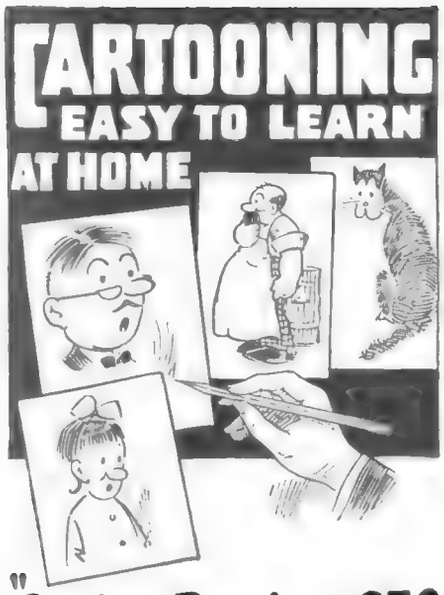

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Free Cathode Rays

(*Continued from page* 728)

a calcium "getter" tube attached to the cathode arm of the tube. When any gas such as oxygen is detected in the main tube, the filament of the "getter" tube is lighted and chemical combination takes place in the smaller tube between the calcium and the gas, thus removing the gas from the main tube.

The electrons are generated at the cup-shaped cathode and as the end of the copper tube is at the same positive potential as the window is, the electrons gain their tremendous velocity (about 0.8 that of light, or approximately 150,000 miles per second) in the short space between the cathode and the end of the copper tube, this space being about one inch. From this point on, the electrons continue with undiminished velocity, until they reach the window. Most of them pass through the window and at a voltage of 350,000 are hurled through the air more than *two feet beyond the end of the tube.*

The bombardment of the air in front of the window, by the escaping electrons, produces a beautiful purple glow. Due to the collisions of the electrons with the atoms of the air the electrons are scattered and the beam spreads out and bends around until it extends perhaps half as far behind the window as it does in front. This bending of the ray is not clearly shown in Fig. 4, but some idea of the scattering effect may be seen.

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Although as yet there have been found no practical applications for these rays that come through the end of the generating tube, there have been some most interesting results obtaind from the experiments which are being conducted.

Before the advent of the Lenard tube, it had been impossible to ascertain the effect of cathode rays on different substances without considerable trouble, due to the fact that whatever was to be studied had to be sealed within the tube. Now thanks to the fact that the rays can be brought out through the window, a vast number of experiments can be performed, with no more trouble than placing the substance in the path which the rays follow at the end of the tube.

A few interesting experiments will now be described.

It is a well-known fact that under cathode ray bombardment, lime becomes luminous and glows with a bright orange color, the glow ceasing immediately when the bombardment stops.

Use is made of this property of lime in an experiment to show the range of the cathode rays in the air in front of the window. A block of lime is moved back and forth in the path of the rays until the point is found at which the orange glow just begins. The distance from this point to the window may be taken as a measure of the range of the electrons at the particular voltage at which the tube is being operated.

Previous experimenters have shown that, while lime is luminous only while it is being rayed, calcite (Iceland spar, noted chiefly for

(*Continued on page* 740)

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FOUR ELECTRODE VACUUM TUBES

(978) Thos. Denike, Caldwell, N. J., has submitted idea for a fourth electrode in a vacuum tube and reasons that the tube should work more satisfactorily with the fourth electrode inserted. He asks whether he should secure a patent on the idea or continue his experiments along that line.

A. After having considered your proposed type of electron tube very carefully, we have arrived at the opinion that we do not believe that such a tube presents any advantages over the present type. It is more complicated in construction and obviously would have to sell at a higher price than the present-day tubes. Furthermore, we do not see any reason why the introduction of the fourth electrode in the position you mention and for the purpose you design it should increase the efficiency of the tube. We do not believe that it would pay you to prosecute this idea as we are very much of the opinion that you could never make a commercial success of it. As witness to this fact, note the Solodyne tube which was recently placed on the market and given quite some publicity. In a short space of time, the manufacturers had to go out of business as they could not compete with the standard three-electrode tube which is on the market today.

GASOLINE TURBINE

(979) Irven Culver, Riverside, Calif., submits an idea for a gasoline turbine having a rotor eccentrically located, said rotor being provided with a series of sliding baffle plates. At the position of maximum compression an explosion is to take place between two adjacent baffle plates and the compressed gases are to drive the rotor around.

A. We do not see that your idea for a gas turbine is practical at all, and we even doubt that you can secure a patent on the system.

The method for compressing gas and also for causing the explosions to occur on the far side of the rotor or in other words under full compression has been employed before. The difficulty of all mechanisms of this nature is that the valves slide, as they enter the center shaft or rotor and the slide is rarely, if ever, gas-tight. The mechanism carbonizes easily and does not give a full-power stroke.

You must also remember that when gas explodes, it acts quickly in all directions. Consequently, there is no reason why your system should move, because the force exerted by the gas will act against the casing as well as against the center drum, and also against both sides of the moving vanes or valves.

We do not advise applying for a patent on the idea.

PUNCTURE-PROOF TIRE

(980) Edward G. Crookes, East Hartford, Conn., asks for patent advice on a puncture-proof tire the nature of which is not described.

There are a great many puncture-proof tires on the market, and we would suggest that you secure a complete group of patents on this same subject from the Patent Office at Washington. These patents will cost you 10c each.

There are puncture-proof tires using air; there are others containing balls of soft rubber; still others which are filled with rubber sponge or other composition, and another group which contains a rubber cement in the center, so that when punctured the tire becomes self-repairing.

We do not suggest a patent on a puncture-proof tire unless it will give the identical riding qualities of the air tire and unless it is absolutely puncture-proof.

REMOVABLE RING STONES

(981) Geo. B. Hess, Jr., North Lake, Wis., requests our opinion of a ring with removable stones and also a cakeless salt shaker, the top of which is to close automatically.

A. The same objections that apply for removable stones for tie-pins apply also for finger rings. Furthermore, in the case of rings, the stones would be subjected to a much greater vibration and amounts of mechanical movements than would be found in a tie-pin. Therefore, unless the lock for holding the gems in position was very strongly constructed, frequent losses would occur. We are of the opinion that such a device is not to be desired and would therefore not advise you to attempt to prosecute the same.

It is all very well to say that a salt shaker with a closing top will keep the salt from caking, but it is quite another matter to design such a closure that will be practical in all ways. You have not explained how the salt shaker top is to be closed and therefore we cannot advise you more fully.

DINNER PAIL

(982) Chas. Coleman, Jr., Mildred, Pa., has designed a dinner pail and requests advice.

A. We do not see anything at all new in your proposed combination dinner pail. However, you do not give any details on the construction of the compartment for containing liquids. This compartment would have to be tightly sealed in order to prevent the liquids from leaking out. However, the basic principle of your whole idea is so old that we are sure a patent on the same would be of no value.

TIMING EXHAUST VALVES

(983) H. Skan, San Pedro, Calif., submits an idea for timing the exhaust valves of a gasoline engine and requests information on its patentability.

A. We certainly do not believe that your proposed automobile device should be patented. We are very much of the opinion that it would not be at all practical and that if ever adopted, it would cause more trouble than it would ever be worth. A system of this nature would be prone to every trouble that is ever found in any mechanical device and probably would have a few that would be peculiar to itself.

Furthermore, we do not believe that the advantages you mention in your letter would be of sufficient value to overcome the complicated mechanism that would naturally have to be used for a system of this nature. Also, the retarding or advancing of the action of the exhaust valve would undoubtedly have a detrimental effect upon those valves which would not be at all desirable.

It is our frank opinion that you should certainly not attempt to proceed further with this system as we do not consider it at all practical.

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Into the Fourth Dimension

By RAY CUMMINGS

(*Continued from page 697*)

which I must play a part. The whole seen and thought of in terms of my own world. And I realized that I—to these others of this other realm—must have seemed a stranger, but not so very strange. Thought of by them in their own terms—each of us upon a common ground, an equality of material state, to visualize the other in terms of ourselves.

CHAPTER IX

THE ATTACK ON THE MEETING HOUSE

AHLA was saying, "At last—it is so good to be back." For her the struggle was wholly past; she was smiling, relieved, and upon her face there was solicitude for us. "You are not injured? At rest—now?"

"Yes," said Will. "It is over." His hand touched Bee affectionately. "The strangeness will soon be gone, I think. You all right, Rob?"

The people we passed did not heed us; the globes, from whatever angle we viewed them, were circular, seemingly flat, but always flat in the unseen dimensions. We passed close to one. It appeared solid. It had no apertures—no doors nor windows. A man went by us—a shape in the guise of a man; and he entered the globe by passing through it. It yielded to his passage; its substance closed after him, opaque, sleek, glistening as before.

"Yes," I said. In truth every moment a rationality of being was coming to me. And curiosity, of itself evidence of normality, made me ask, "Where are we going? What are we going to do?"

"Going with Ahla," said Will briefly." Her people are friendly to us—deploring the threatened invasion of our world."

I realized that he and Ahla at their first meeting must have exchanged knowledge, and planned what we now were to do.

Bee asked, "Are we going far? Will it take long?"

Ahla seemed puzzled. "Far"—"long." The words involved Space and Time. I saw that at first they had no meaning to her.

"We are going there," she answered. Her gesture was vaguely downward ahead of us. "Come," she added.

We started. My impression now is that we were walking. I could feel a part of my body in movement, quite as though of my volition I were moving my legs. A sense of lightness again possessed me; a lack of

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stability. But I could feel solidity beneath me, and I was moving upon it.

We walked then, down the hill. There was vegetation; things, let me say, seemed rooted within the ground. But they bent from our advance as though with a knowledge and a fear that we might tread upon them.

The scene was no longer empty. A rolling land, with what might have been a mountain range rising in the distance. All in that half-light of seeming phosphorescence. I noticed now that the familiar convexity of earth was gone. The scene had a queer concavity; to the limit of my vision it stretched *upward,* as though we were upon the inner surface of some vast hollow globe with the concave darkness overhead coming down to meet it. A hollow globe within which we were standing; but it seemed of infinite size.

Not far away now was that region which first I thought was water. We passed over it—partly through it. I felt the resistance against me. Like water with no wetness; but to my sight it was a heavy fog lying upon the land. Its breath was oppressive; I was glad when we were past it, emerging again into the twilight with a city before us.

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A city! Houses—human habitations! I knew it—divined it with a new mental alertness; and Ahla's words presently confirmed my thoughts.

"Our Big-city," she said.

Before us lay an area upon which was spread a confusion of globes. Circular, yet visually flat of depth. In size I found them later to be, from the smallest some twice my own height, to others I would in my own world have said to be a hundred feet in diameter. Opaque grey globes, of a material unnameable. Of every size they lay seemingly strewn about; and in places piled one upon the other. All of grey color that glistened with a sheen of iridescence.

The Big-city. Diminished by distance it seemed indeed as though a thousand varying-sized soap-bubbles, smoke-filled, lay piled together. And the whole flattened, queerly unnatural like a picture with wrong perspective.

The globes were scattered about; but as we approached I saw open spaces twisting among them like tortuous streets. Horizontal streets; and vertical streets as well. Abruptly I realized that this realm was not cast like my own upon a single plane. On earth we move chiefly in a world of two dimensions—only in the air or water do we have the freedom of three. Here, the vertical and the horizontal seemed no different.

Bee said, "The Big-city. Houses—" Her voice trailed away into wonderment. From our presently nearer viewpoint, movement

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showed in the city; beings—people like our selves—moving about the streets. And soon we were among the globes—within the city.

I say "soon." I can remember no conception of time, save in terms of the events within my ken. How *long* it was from our crossing the borderline until we reached the city I do not know—we moved, walked and entered the city. How far we walked—that too I do not know.

The people we passed did not heed us; the globes, from whatever angle we viewed them, were circular, seemingly flat, but always flat in the unseen dimension. We passed close to one. It appeared solid. It had no apertures—no doors nor windows. A man went by us—a shape in the guise of a man; and he entered the globe by passing through it. It yielded to his passage; its substance closed after him, opaque, sleek, glistening as before.

We stopped at a globe of larger size. Ahla said, "I will leave you here. And when I come back—we will go together to the meeting place. They are waiting for you."

Will nodded. "Very well, Ahla. How long before you come?"

Again she was puzzled. "How long? Why I will come."

Articles In December "Radio News"

The Loud-Speaking Christmas Tree, By Hugo Gernsback.
The New Hammarlund-Roberts 5-Tube Receiver, By V. T. Baird.
Electrifying Your Phonograph, By H. B. Whiffen.
All About Loud Speakers, By M. L. Muhleman
Home-made Coils for the Browning-Drake, By C. A. Oldroyd.
Magnetic Fields in Vacuum Tubes, By Robert Serrell.
The Improved "Bass Note" Circuit, By George V. Rockey.
An Infradyne Combination Set, By Clyde J. Fitch.

She left us; I did not see how or where she went.

Will said, "Come on. This is our house they have given us."

Together we passed through the side of the globe. I felt almost nothing—as though I had brushed against something, no more. Were the globes of a material solidity? I do not know.

Within the globe was a hollow interior. Call it a room. The same luminous twilight illumined it. A room of circular concavity. No walls, no ceiling; it was all floor. We walked upon it and though we had passed through it, nevertheless it sustained us; and in every position beneath us seemed the floor, above us the ceiling. A memory of the vanished gravity of our earth came to me. The word—the conception—had no meaning here. Yet we had *weight;* the substance upon which we rested attracted us perhaps. I cannot say.

We gazed around us. There were places of rest—rectangles of a misty white into one of which I found myself instinctively reclining as though with a need of physical quiet. A sense of ease came to me; but it was only vaguely of the physical. I was indeed now barely conscious of a body; but of my mind I was increasingly aware. I could be tired in mind. I was, and I was resting.

Will and Bee were resting also. I saw upon Bee's face that same queer, wistful expression which had marked Ahla's; I

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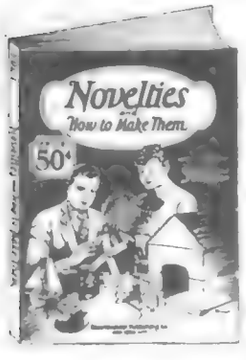

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saw her regarding me intently; and I answered her affectionate smile.

Will said, "The strangeness is leaving us. I'm tired—I wish I did not have to talk, but I feel that I should."

He told us then what he had learned from Ahla. This Big-city was the most populous place of the realm. Ahla's parent—I might say her father, to make the term more specific—was leader of the Big-city people. One among them—one whom they called Brutar—had found a way to get into the Borderland. He had gone there—and I think that it was he whom we termed the first of the ghosts—whom we had seen that night on the little Vermont farm. He had returned, with tales of an outer world. . . tales of the consciousness of a different body . . . a physical being with pleasures unimagined. . .

The craze to follow him spread. An element undesirable among the people seemed most inspired to join him.

"Ahla told me little more than that," Will went on. "The method they are using to get to the Borderland—I do not yet know. But I know that this Brutar—he would sweep with his followers into our world. Physically possessed, in a fashion they could not understand. . . "

He stopped with the sentence unfinished; it left me with a memory of that Kansas farm-house, and of the young girl who had died of fright.

Bee asked, "What do they call themselves—these people? This race—beings—" She floundered. "There are no words, yet I have so much to ask."

He shook his head. "All that we have to learn. There is a civilization here—a mental existence in which we'll soon be taking a rational part. For myself, it is less strange every moment."

I nodded. "And Ahla's people—they refuse to join in this invasion of our world?"

"Yes," he said. "They deplore it—they're trying to stop it. A meeting is to be held—Ahla is coming to take us to it."

I drifted off into a reverie; and Ahla came. I glanced up to see her beside us.

"If you are ready," she said, "we will go."

Again we passed through the enveloping globe which was our home; passed along the city street. It was now deserted. We walked on its level surface; it wound and twisted its way between the globes. At times a group of them piled one upon the other—the smallest on top like a disarray of bubbles—obstructed the street. But the substance upon which we walked (it was often barely visible) turned upward; a sharp upward curve to the vertical; then straight

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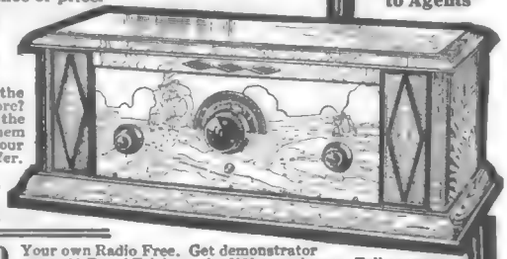

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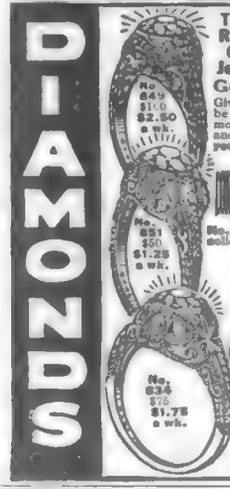

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up, again leveling off, and then downward. We trod it; with no more effort going up than upon the horizontal. It seemed, indeed, only as though the scene about us had shifted its plane.

In silence we proceeded. I wondered where the inhabitants of the place might be. Then I saw a few. Not walking openly, these few we now encountered; one I saw lurking in the curve between two adjacent globes. A man . . . robed darkly . . . a dark hood seemingly over his head . . . like a shroud enveloping him to mingle his outline with the darkness . . . Darkness? Had the twilight turned to night? . . . Was this the Borderland again? . . . I seemed to see its darkness . . . I strained my vision for the familiar shadows of our own world . . . Was that a tree? . . . A street? . . . Was that Will's house over there? . . .

Bee's agonized voice reached my consciousness. "Rob! Rob dear, come back to us!"

My mind had wandered, and had drawn with it the tenuous wraith of a body it so easily dominated. I fought myself back.

We passed through one of the bands of the gigantic globe, and found ourselves in a single great room. A globular amphitheatre; to use earthly measurements it had perhaps a thousand feet of interior diameter. Its entire inner surface was thronged with grey-white shapes of people. . . .

Told myself vehemently I was *not* in the Borderland; I was with my friends. With Will—Bee; with Ahla.

I saw them, distantly; with Space I know not how much, nor Time, how long—between us. Saw them; saw Bee with horrified arms held out as though to bring me back. And felt myself whirling in Nothingness.

"Rob! Rob!"

"Yes," I called. "I'm here—coming." And at last again I was with them.

"You're careless, Rob." Concern mingled with the relief in Will's tone. "Careless—you must not wander that way."

Ahla said quietly. "There are many like that. A wandering mind brings evil to the body it tosses about."

"But with us now, it is additionally hard" Will said. "Every instinct within us draws us away—as it was with you, Ahla, in the Borderland."

"Yes," she agreed. "I know that."

We continued our passage toward the meetinghouse. That shrouded shape I had seen was not of my wandering fancy, for now I saw others. Peering at us from dark spaces; eyes that glowed unblinking; or shapes of mantled black skulking furtively along the streets. Avoiding us, yet always watching as we boldly passed.

"Brutars," Ahla said. "Those who with Brutar would attack your world. They are

everywhere now about the city. I am afraid of them."

We came upon the meetinghouse. It was a tremendous globe, in outward aspect no different from the others save that its size was gigantic. As we neared it I saw that upon its luminous grey surface were narrow circular bands of a lighter color—bands both vertical and horizontal. These also I had noticed on most of the other globes; a lighter color in bands, or sometimes in small patches. I questioned Ahla; the lighter-colored parts were where one might safely enter, thus not to encounter the occupants, or the furnishings within.

We passed through one of the bands of the gigantic globe, and found ourselves in a single great room. A globular amphitheatre; to use earthly measurements it had perhaps a thousand feet of interior diameter. Its entire inner surface was thronged with grey-white shapes of people, save where, like aisles, the space of the outer bands divided them into segments.

The segments were jammed; the people seemed crouching upon low pedestals one close against the other. A few of the pedestals were vacant. None where we entered, and the nearest I saw were almost above us. We passed along an aisle to reach them. The globe and everyone in it appeared slowly turning over, so that always we seemed to be at its bottom with those opposite to us over our heads.

At last we were seated. In the center of the globe, suspended there in space by what means I could not know, was a ball some fifty feet in diameter. Upon it men were sitting. Dignitaries; leaders of the people facing from every angle the waiting throng. And one—a man of great stature—Ahla's father, walking around the ball restlessly, awaiting the moment when he would begin his address.

A silence hung over everything. Again I was reminded of the utter soundlessness of this realm. I felt the suppressed murmurs of the people—but I know no physical sounds were audible. Nor ideed, had I ear-drums with which to hear them had such sounds existed.

Time passed as we found our seats. Immobile we sat; and for me at least, time ceased to exist.

Then Ahla's father spoke. "My people—danger has come to a strange race of friendly neighboring beings. And it brings a danger also to us all—to you, to me——"

He stopped abruptly. I felt a sound; a myriad sounds everywhere about us. Shouts of menace; a swishing, queerly aerial sound as of many rapidly moving bodies.

Through all the aisles of the globe, from outside, the shapes of men were bursting. Swishing through the opaque surface of the globe, entering among us, whirling inward. Like storm tossed feathers they whirled, end over end, uncontrolled with the power of their rush. A cloud of hostile grey shapes in the fashion of menacing men come to attack us!

—END OF PART 4—

Radio Wrinkles Wanted!

The Radio Editor, Mr. J. Francis Clemenger, wants to hear from you, if you have a good idea or wrinkle. Make a pencil or pen and ink sketch of the contrivance, write 50 words or so of description, and mail to the Radio Editor, c/o this magazine.

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WITH the coming of the long winter evenings, the best time of the year is here for the man with the Home Work Shop Hobby. What articles of furniture are you planning to make this winter? Whether it is a radio cabinet, end table, book case, cedar chest, or any other piece of household furniture, LePage's New Books can be of practical help to you.

"LePage's Practical Suggestions for the Home Work Shop", and "LePage's Gesso-Craft Book", will help you come closer to equalling the skill of the trained cabinet maker, turning your evenings spent on this hobby to better account. They tell you how to make strong joints with glue, and not only with glue, but with glue in its most convenient form—LePage's Liquid Glue.

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Free Cathode Rays

(*Continued from page 730*)

its property of double refraction) retains its luminosity for several hours after being subjected to the cathode rays.

When subjected to the powerful radiation from the new tube, calcite shows, in addition to the orange glow, bright bluish scintillations or sparks. These continue to occur after the raying even for as long as a minute. The area in the neighborhood of these scintillations loses all luminosity as the scintillations occur and then appears black against the orange of the glow. When these spots are subsequently observed under a microscope they are marked by a minute crater with tiny straight canals running at right angles to one another and parallel to and about 0.01 of an inch beneath the surface. From the microphotographs in Fig. 8 it will be seen that the canals are not continuous channels; but appear to be frequently interrupted, looking like dotted lines in the crystal.

When a thin sheet of celluloid is rayed at a very low temperature, craters are formed as in the case of calcite, but the canals leading to them are curved and of no regular formation. Although the causes of some of the peculiarities of these craters and canals is not yet fully understood, the difference in the form of the canals in these two substances is due most likely to the fact that calcite has a crystalline and celluloid a non-crystalline structure.

The effect of the cathode rays upon such an organic substance as glue is very remarkable. Two small circular areas on the piece of glue have been exposed to the rays, but not visible effect is producted until the sample was subsequently gently heated. Then the exposed areas lose their brown color and become white. Examination under the microscope shows the exposed areas to be full of minute gas bubbles.

Another interesting effect to be observed is the action of the rays upon acetylene gas (C_2H_2). Several grams of a yellowish-brown powder have been formed and this material has been found insoluble in all of the many different chemical agents which have been tried. Also under the influence of cathode rays, castor oil rapidly changes into a solid material; crystals of cane sugar turn white in color and upon heating, give off quite a bit of gas, and an aqueous solution of cane sugar becomes acid to litmus upon being rayed.

That temperature in some cases has a marked effect upon results produced by the cathode rays is shown by an experiment performed on a card coated with cadmium tungstate. At room temperature the cadimum tungstate glows with a brilliant bluish light, and as soon as the ray is turned off, the material is no longer luminous. However, after allowing the card to remain in liquid air for about 30 seconds and then placing it in the rays for an instant, the bluish glow quickly fades out and as the card warms up from —180 degrees Centigrade to room temperature, it undergoes a series of brilliant color changes.

EFFECT OF CATHODE RAYS ON PLANT AND ANIMAL TISSUES

A portion of the leaf of a rubber plant, when rayed with one milliampere for about 20 seconds, was immediately covered with white latex, as though the walls of the cells of the leaf had become ruptured. This same effect could be produced by pricking the leaf of this plant at a great many places with a sharp point. Even though the exposure was reduced to 1 second and the current to 0.1 milliampere, there was a color change with a subsequent drying-out of the

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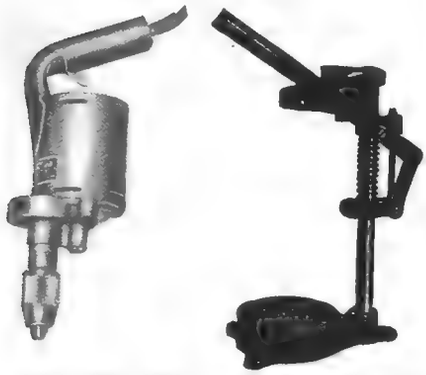
rayed area to a depth corresponding to the penetration of the rays.

A portion of the ear of a rabbit was rayed with 1 milliampere of current for 1 second. After a few days a scab formed over the rayed portion of the ear (Fig. 10, right) and in another few days the scab came off, taking the hair within that area with it. In about two weeks after this, (Fig. 11, left) snow white hair started growing on this spot and soon became longer than the original gray hair. Another area was rayed with 0.1 milliampere for 0.1 of a second. The effect was much less marked, as is shown by the upper part of Fig. 10, and when the hair came back again it was partly gray and partly white.

HOME SHOP TOOLS



Indispensible electric hand drill. **Home mechanic's drill stand to fit hand drill.**

Electric hand drill mounted on base to accommodate emery wheel or buffer, etc.

Photos courtesy Electro-Magnetic Tool Co.

FOR drilling radio panels and dozens of other purposes, the electric hand drill shown above will prove indispensible. The ordinary hand drills and breast drills, do the work very well, but the average home mechanic and radio set builder today finds the common hand drill far too slow. This electric motor-driven hand drill illustrated above is a universal tool, the makers supplying it also furnishing drill press stand and the grinding wheel support shown in the lower picture.

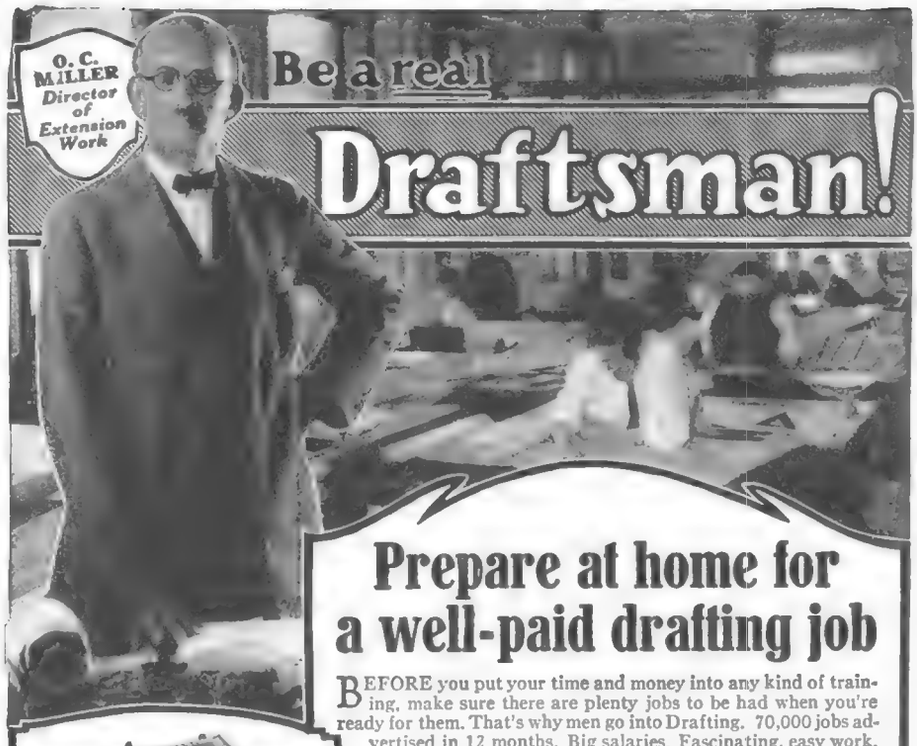
Motor Hints

(*Continued from page* 706)

To use this means, either convert one of the socket handles to fit the jaws of the brace or make up a part from cold rolled steel that will allow of rotating the socket with the brace.

A single socket bar or handle, will permit of use of all the sockets in the set, in the same brace.

Naturally, the use of the brace is not confined to cylinder head bolts alone, as the same brace means of turning the socket is applicable to removing tires, transmission bolts or for work on any of the bolted members in the car. This simple means makes overhaul and adjustment work far less tedious.



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Home Mechanics

By W. M. BUTTERFIELD

(*Continued from page 707*)

bit and with yellow for wheels, shaft and handle.

Following this is a bird toy (C) with weighted rockers. It is made of ⅜" plywood. The rockers are weighted by boring ½" holes and filling with bar lead slightly riveted into the wood at each end. If a small, flat spot is made about the screw head on the bottom of the rockers, the toy will come to a stop, when rocked, in an upright position, otherwise it may end its rocking and come to rest in an inclined position. The toy is painted with red beak, green body with black outlines, black wings, yellow legs and black rockers.

The rocking bird shown at (D) is made of ⅝" plywood and is a roomy, unbreakable and safe toy. Five ¼" iron rods are riveted in the positions shown to hold the sides firmly in place. Washers are provided and put over the ends before riveting. The washers lie flush with the surface of the wood. The shallow holes for the washers are counterbored by using a bit of the diameter of the washers first, then a smaller one for the rods afterwards. The holes can then be filled, when the rods have been riveted in place over the washers, with putty, giving a smooth painting surface for the outside parts. The rocker is painted white with black markings as shown. The beak of the bird is yellow and the inside of the seat, the handle bar, shelf, foot rest and floor is blue. All the other inside parts are painted white.

A small variety of kiddy-car, or a coasting or push car is shown at (E). This car is made of ⅝" plywood and is constructed in exactly the same way as the kiddy car already described (A). Cord attached to the front shaft can be used to pull the car. It is painted with yellow platform, red wheels and under-parts and brownish red for the monkey figure. Black is used for outlining the figure—that is drawing the arms, ears, eyes, etc. The ears are used as handle bars as on the kiddy car (A).

An automatic toy is shown at (F). It is made of ⅜" plywood and represents a swan that rocks backward and forward as the toy is drawn over the floor. The crank shaft is made by bending a brass rod of the desired size, (say ⅛") as shown. The wooden wheels are secured to the shaft by means of washers that are first screwed to the wheels, then deeply grooved with a round file (see detail).

The groove fits over a pin in the shaft and is held against the pin by another washer on the opposite side of the wheel, also held in place by a pin driven through the shaft. A third washer holds the shaft, wheel and crank in place on this side. It is placed as shown on the inside of the hanger-post. This washer is also held in place with a pin in the shaft. The connecting rod is made of a brass rod with flattened ends (made flat with a hammer). The holes are large enough to slip over the crank shaft, then over the bent parts of the crank and thus into place. The bar is held in position, when the toy is fully assembled, attached to the slotted projection on the swan's body, by a pin passing through it and through this slotted part. The toy is painted with a white swan having a yellow bill and black markings, a green wagon body and under-parts and with red wheels and handle.

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In the January Number

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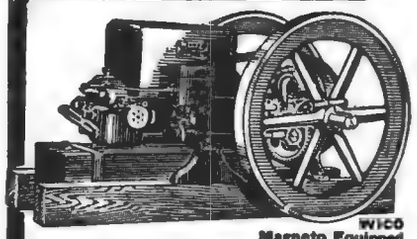

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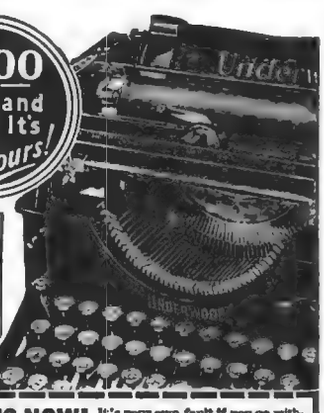

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By A. P. PECK

(*Continued from page* 719)

the yoke. This provides a two control receiver which is far more selective and flexible in tuning than any single control receiver, yet that will give many of the advantages of three, or four-control sets. In Fig. 7, the "cans" have been replaced over the various units. Note that everything is enclosed, and there is no possible chance of stray currents from the radio frequency amplifiers interfering with each other or with the audio-frequency amplifying parts of the receiver.

It will be seen in the diagram that the negative filaments of all the tubes are grounded to the chassis. This is most easily accomplished by means of the little stunt shown in the various photographs and in particular in Fig. 3. Two soldering lugs are employed for this purpose. One of them is placed under the set screw which makes connection to the negative prong of the tube through the socket. The other one is placed under the head of the mounting bolt adjacent to the set screw. The two lugs are turned to overlap and then soldered together. This makes a very neat connection between the metal base and the negative lead, and eliminates the necessity of making a wire connection between these two points. This stunt may be carried through, and in fact should be carried through, on all six of the sockets. Failure to do this will result in an open filament circuit at some point throughout the set.

Some of the readers may be puzzled to account for the placement of certain of the fixed condensers used in this particular receiver. Some of them are visible in the circuit diagram in Fig. 2, but not in the various photographs. This is because of the fact that they are mounted underneath the metal chassis. Reference to Figs. 6 and 7 will show that the chassis is in a pressed form and has a raised edge. This allows ample room under the base for wiring and for the placement of certain of the fixed condensers. It is also usual to place a ½-ohm filament resistance, the two small switches and the special 25,000-ohm potentiometer in this position. This puts them out of the way and still in a convenient location for wiring.

When assembling a receiver of this nature, and before attaching the panel, be sure the three yoked variable condensers are placed correctly in position. Possibly the best way to do this is to slip the three collars on the three shafts and then turn the condensers to minimum capacity. This point can be held by cutting three short strips of rather thick cardboard and placing them before the ends of the rotor plates and the ends of the stator plates on the side where the two will start to mesh. Closing the rotor plates over this strip will hold it in position and will cause the strip to serve as a guide and to keep all three of the condensers at the same capacity while the yoke is being placed in position and fastened. When this operation is accomplished, a 180 degree rotation of the controlling shaft will cause a like rotation of the other two variable condensers. This adjustment cannot be carried on quickly and must not be slighted as the receiver will not operate properly if the three condensers do not travel in perfect unison with each other. If, after the set is assembled and placed for operation, stations will come in at two points on the dial that controls the single condenser, this indicates that the yoke mechanism is not set correctly. Therefore, the adjustment method described above should be carried through again until proper results are obtained. When

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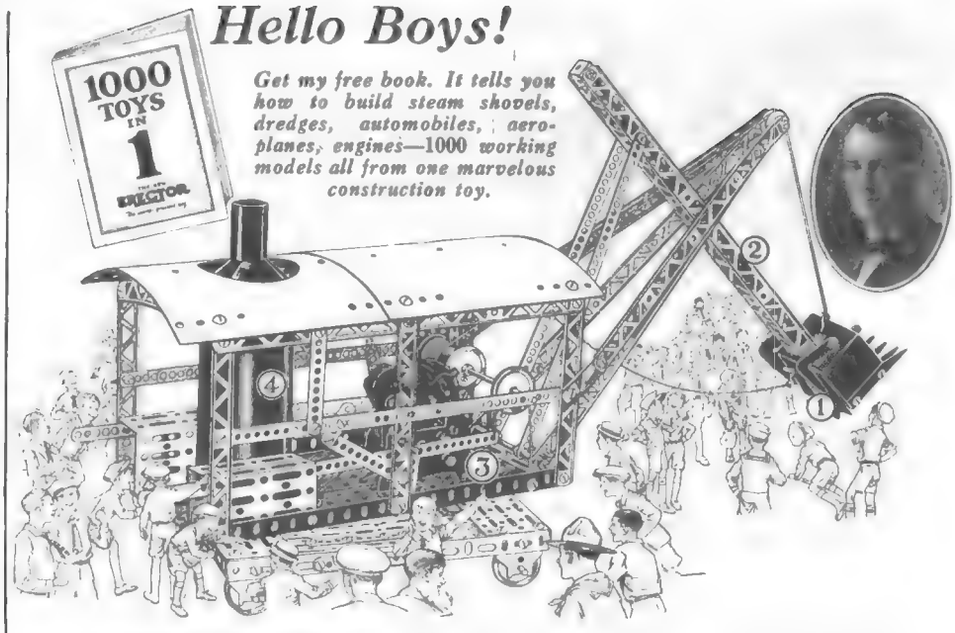

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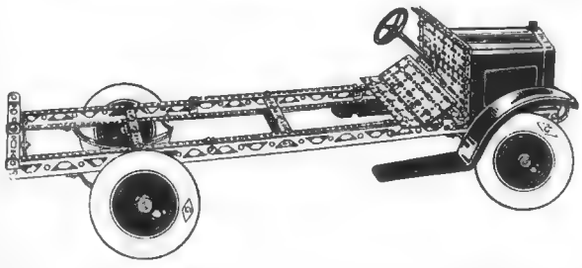

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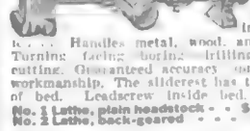

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the condensers are adjusted correctly, stations come in only at one point on either dial.

The audio frequency amplifying end of this receiver is of the standard two stage transformer-coupled type having a special output transformer which is employed to prevent the high voltage DC from reaching the talker. This is all indicated in the circuit diagram in Fig. 2. One point that must be impressed is the connection of a .25 megohm (250,000 ohm) resistance across the secondary of the first audio amplifying transformer. This will assist materially in providing good reproduction of the received signals.

In the receiver as designed, no provision is made for using less than the two stages of audio-frequency amplification. To do this would only cause further complications, and the average radio user today desires quite a bit of volume. However, the stabilizing potentiometer will also be found to operate as an excellent volume control. It may be used for this purpose as well as for preventing oscillation. It will be found that as this control is turned toward the left, the signal strength will decrease gradually until it reaches practically zero. When the direction is reversed, the volume will increase up to a certain point and beyond that point a squeal will develop. This indicates that the circuit is in a condition of oscillation and should not be allowed to continue thus. Always keep the knob just to the left of the point where a squeal or click is heard.

After setting up a receiver of this nature and checking over the various connections for continuity, the "A" battery circuit should be tested. To do this, leave one terminal connected to the negative "A" post and touch the other wire to each of the other binding posts in succession. This should be done with a tube and one of the sockets. If the tube lights when connected to any terminal other than the positive "A" post, there is a wrong connection and it must be found before the "B" battery is hooked up.

After everything is correct, the shield should be placed over the three radio-frequency stages, and the set should be placed in its cabinet. It is important that an overall cabinet be used for housing this receiver. This serves to deaden mechanical vibrations from the loud-speaker which might otherwise set up an unpleasant noise in the set. This is evidenced by a hum caused by feedback from the loud-speaker, or a "drum" effect when low notes are reproduced. Removing the loud-speaker from the vicinity of the set and placing the set in the cabinet tends to reduce mechanical vibrations and vibrations due to sound waves to a minimum.

With a sensitive receiver of this nature, the "A", "B" and "C" batteries should always be of the best. A run down battery will change the operation of the set considerably. If the "A" battery becomes weak, an occasional high pitched squeal will often be evidenced. Depleted "B" or "C" batteries will cause the reproduced signals to sound unnatural, particularly on the low notes.

Furthermore, a sensitive three-stage radio frequency amplifying set of this nature should not be operated without the shields for which it is designed. Here again unpleasant and unsatisfactory results will be found if this warning is ignored.

As indicated in Fig. 2, the first five tubes are of the UX 201A type, while the sixth tube should be of a power type such as the UX 171. If this is carried through, the receiver here described will give maximum all around results.

A complete list of parts required for this set will be forwarded upon receipt of a stamped, self-addressed envelope mailed with your request to the Radio Editor.

—Photos courtesy Silver-Marshall.

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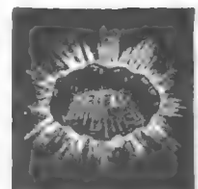

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Sir Oliver Lodge's "N" Circuit

By JAMES FRANCIS CLEMINGER

(*Continued from page 721*)

tion, 5XX, at Daventry, England. This switch is fitted inside the receiver and, the switch is moved so that for the 300- to 500-meter wavelength band a condenser of .0003-mfd. can be inserted if necessary, while for the 1,600 meters one of .0003 or .0003 + .0004, or .0003 + .0004 + .0005 can be inserted if necessary.

For the broadcast wavelength of 1,600 meters both the "A" and "N" coil have to be substituted for by another "A" and "N" coil respectively. For 1,600 meters the "A" coil has 220 turns, while the "N" coil has 500 turns. The rest of the circuit needs very little explanation.

It will be seen in this case that the filament is grounded and this was found to give the circuit much greater stability. Only one filament rheostat is included in the set and this is found to be quite sufficient for adequate control of filament supply. The "B" battery voltages vary according to the type of tube used.

The photographs which illustrate this article show the back of panel layout and wiring of some of the first two-valve Lodge "N" set receivers. So far Lodge "N" sets using radio-frequency amplification have not been put on the market, and I understand that there is still some experimental work to be done before really satisfactory R.F. amplification can be obtained. But from the tests I have made and from advices received from those in personal contact with Sir Oliver, I have satisfied myself that a two-valve Lodge "N" set as illustrated in Fig. 4 gives better volume than an ordinary straight two-tube set with regenerative detector; and furthermore its selectivity is considerably greater.

It must be remembered that one of the fundamental principles of the Lodge "N" circuit is the employment of a single connection between the aerial system and the detector tube. The "N" circuit principle is included between the aerial and the detector tube and, as will be seen from the diagram, this circuit consists of a variable condenser in parallel with an inductance and it is therefore a resonant circuit. The aerial itself, including the "A" coil, is, however, a non-resonant circuit and is heavily damped. Therefore the resistance in the resonant circuit being very low, high voltages may be generated by comparatively small voltage impulses.

Sir Oliver Lodge maintains that for good quality of reproduction there should not be more than one tuned circuit, as if two tuned circuits be employed there is great liability to distortion due to heterodyning between the circuits. So you will see that in the "N" circuit, the coil is made of a very high inductance value while the capacity of the condenser is small and, owing to the much greater wavelength of the aerial system and to its damping, radiation from the aerial is practically impossible. This has been proved by the fact that, in recent dual broadcasts from the London broadcasting station, the wavelengths were separated with the greatest ease, and it will also be found that static is reduced very considerably and that for short-wave work the circuit has many advantages.

Although in operation the set can be made to oscillate itself, the radiation from it is entirely negligible and extensive tests have shown that it is practically impossible to cause interference with neighboring sets.

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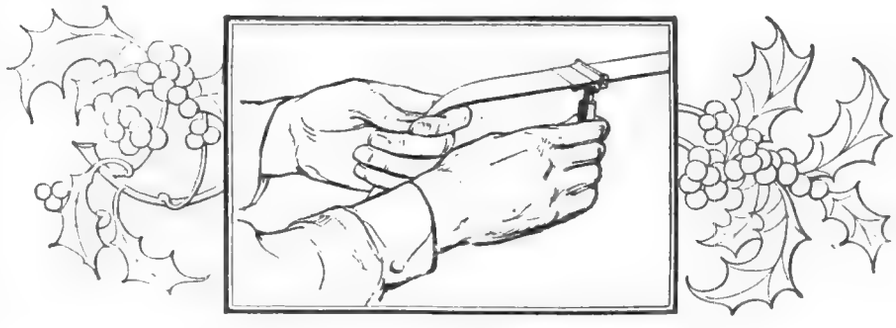

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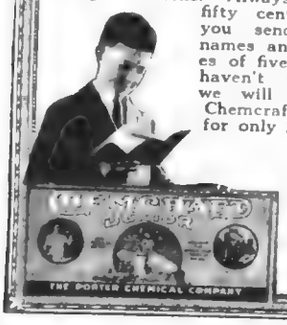

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that in designing the "N" circuit his object was first to provide a radio set that would not oscillate or cause interference with another neighboring set (and in Great Britain this is very necessary, for the bug-bear of howling is very bad indeed), and secondly to provide a set which would be perfectly simple to operate and yet would give all the programs from the local station and from the special station at Daventry without the use of regeneration and without increasing the number of tubes as would be necessary after to bring up the volume upon the elimination of regeneration.

"If," said Sir Oliver Lodge, "the 'N' circuit be universally adopted there would not, in my opinion, be any further oscillation nuisance. Moreover, the set is simple and efficient; it involves no complications and it is essentially a family wireless set. My hope is that it will make possible the enjoyment of wireless reception by the vast section of the public who have hitherto felt afraid of its technicalities. With the 'N' set there are practically no technicalities; the tuning is very simple and the set should thus make in the widest sense a popular appeal; I hope it may solve a problem and supply a want."

This article, while theoretical, should furnish considerable food for thought to the experimentally inclined of our readers. The circuit has been redesigned and adapted in our laboratories to meet American conditions, and you will find a complete constructional article of a particularly excellent 4-tube receiver, using the "N" circuit, in an early issue of this magazine.

Model Department

(*Continued from page 700*)

Rules for Model Contest

1. A handsome trophy cup engraved with your name, will be awarded as the prize for the best model submitted during the month. The decision of the judges will be final and will be based upon, A—novelty of construction; B—workmanship; C—operating efficiency of the model as related to the efficiency of the device which the model simulates, and D—the care exercised in design and in submitting to us sketches and other details covering the model.

2. Models of all kinds may be entered. They may be working models or not, according to the subject that is being handled.

3. Models may be made of any available material, preferably something that is cheap and easily obtainable. Models made of matches should not be submitted to this department but should go to our Matchcraft Contest Editor.

4. Models must be submitted in all cases. Good photographs are also highly desirable and where the maker does not desire the model to be taken apart, legible drawings with all dimensions covering parts that are not accessible must be submitted.

5. Models should be securely crated and protected against damage in shipment and sent to us by parcel post, express or freight, prepaid. Models will be returned when requested.

6. Models for entry in any particular contest must reach this office on or before the 25th of the third month preceding date of publication. For instance, models for the November contest must reach us on or before the 25th of August.

7. Address all entries to Editor Model Department, c/o Science and Invention Magazine, 53 Park Place, New York City.

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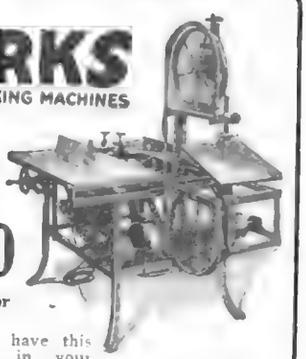

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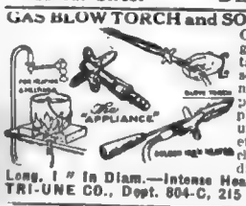

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The Astrology Humbug

By JOSEPH H. KRAUS

(Continued from page 692)

and the wise man can control the stars, would not the phrase, "a fool obeys," contradict the statement that "only thinking individuals are influenced by the stars?"

Here are but a few letters from those who are either student astrologers, astrologers or those interested in the subject and our answers thereto.

THE ASTROLOGY HUMBUG—SOME LETTERS FROM ASTROLOGERS AND ANSWERS

Editor, SCIENCE AND INVENTION:

I have read your article in the October number of SCIENCE AND INVENTION assailing the truths of Astrology, and I note your offer of $6,000.00 for proofs of the science, but inasmuch as you yourself are to be the judge, jury and prosecuting attorney of the case, and your article discloses abundant evidence that you are innocent of any proper knowledge of the science, I do not propose to accept your offer and enter the contest.

However, if you are still anxious to get the truth, and are willing to publish it, I am ready to write you an article in refutation of your unsound statements regarding astrology. This article will be supplied to you at the usual magazine terms for scientific papers. (*Our rates are higher.—Ed.*)

In addition I should like to state that in the article by Mr. J. H. Kraus termed "The Truth About Astrology" wherein he states that he sent Prof. Gustave Meyer, an astrologer, the data of a person requesting the horoscope of the same, Mr. Kraus admits that he supplied the wrong sex, stating that it was a Miss instead of a Mr. Had he known the very simplest elements of the science of astrology, he would have known that the sex is always required for a correct judgment; hence the mistakes in the horoscope. The entire article discloses the fact that Mr. Kraus' knowledge of the science is not even elementary.

Should you still be anxious for the truth the article mentioned will be supplied you at the terms quoted; and the difficulties of the twins which seem to disturb your mind will be set at rest.

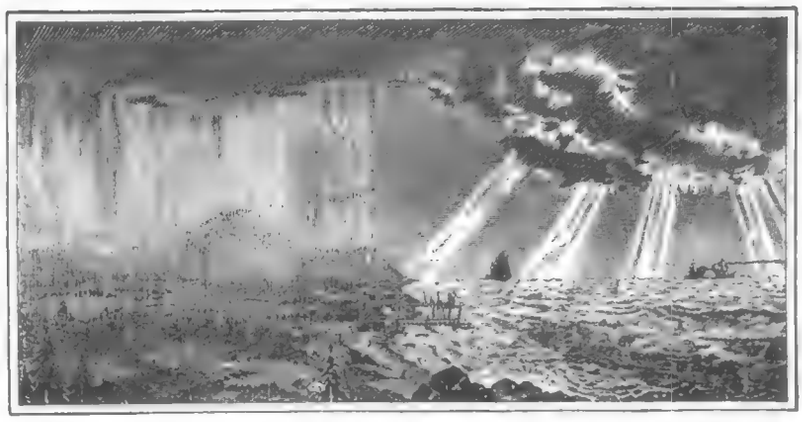
ALEXANDER ELLIOTT,
Analytical and Consulting Chemist.
Los Angeles, Calif.

You have evidently not read the article on astrology correctly. You will note that the writer gave his own address as being that of Miss Florence B. and impersonated her. Please read the writer's letter to the astrologer again and again. The facts in the case are that Florence B. was a Miss, that she was born on the date and at the time specified in the article, and also that she died at the time and date likewise specified. It may also be interesting to you to know that this same astrologer, Prof. Gustave Meyer, stated that Jack Dempsey must win his fight against Gene Tunney. He cast the horoscope for both of these individuals. According to the horoscope, Gene Tunney could not possibly win. He was entering the fight on a particularly unlucky day, with the stars very unfavorably set against him. Jack Dempsey, on the other hand, according to his horoscope, would have things his own way.

Had the astrologer "guessed" correctly, it would not have been anything wonderful, inasmuch as the betting odds were in favor of Dempsey to win at 7 to 1 before the prizefight started. The results not only astonished fighting habitues, bettors and promoters, but it also gave the subject of astrology a 1-2 blow, knocking it out completely as far, at least, as this example was concerned. Is this not another sample of the horoscope humbug?

If you can give an astrological reason why the two Blazack twins had different lives, why one married and had a child and the other did not, and if you can eliminate from this reasoning, natural causes, such as environment and associations, basing your reasoning purely on planetary configurations, we shall certainly be glad to read it with a view toward determining its availability for publication. The writer will admit that he knows very little about astrology. He merely knows enough not to be fooled by those professing to be able to cast horoscopes.

Our judgment in awarding prizes of any nature has never been questioned heretofore. We believe we are just as able to judge an astrology contest as we are able to judge a $5,000.00 Matchcraft Contest, a $5,000.00 Perpetual Motion Contest, a $21,000 Spiritualism Contest, a $3,000.00 Wirekraft Contest and kindred others. What we desire is evidence, and if the evidence is accurate we shall pay the prize monies. If it is not accurate, naturally the prizes will not be paid. We shall mention now, that at the close of this contest we shall publish the complete details of the lives of the individuals upon whom horoscopes are now to be cast, and we are confident that the prize winners, (if there are any) will have made correct statements, whereas all of the others, who fail, will know just in what particular points they failed.—Editor.)



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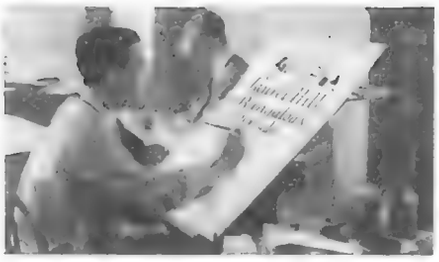

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Editor, SCIENCE AND INVENTION:

For the past six years I have been reading your articles with a great deal of interest, especially as you have shown yourself to be a man of wonderful vision and far in advance of your times. This being the case, I was surprised and disappointed by your editorial in the current issue of SCIENCE AND INVENTION.

Frankly, I am favorable to the claims of astrology, and this fact you may attribute to my ignorance if you please to do so, for I was reared in the backwoods of Florida and have never attended school or any other "institution of learning." My protest against your editorial is not, however, intended to prove the truth of this science, for my knowledge of it is too small to warrant me in such an undertaking. All I wish to do is to point out that some of your assumptions are not in harmony with the facts of the case. I am certain that you had no intention of being unfair, and you can easily verify the statements I am going to make.

In the fourth paragraph you ask why a planet should be supposed to influence a person "exactly at birth," and not before or after. Some astrologers count the life of the subject from the moment of conception, while all teach that he is influenced by the planets during the whole course of his life.

In the fifth paragraph you ask why the lower animals should not be affected by planetary influences as well as human beings. Astrology teaches that they are; but naturally not many people care to have a horoscope cast for a dog or a cat.

In the sixth paragraph you say: "Furthermore, if the astrologers are right, then every human being born at the same instant all over the earth should have exactly the same horoscope and the destiny of each should be exactly alike." But astrologers who are thorough in their work require you to give the place as well as the date of nativity. (*Correct, this was inferred. See contest conditions; location of birthplace is gladly given.—Ed.*) You can readily see that a planet rising in one part of the earth is setting in another, for instance. Again, you call attention to the indisputable fact that sometimes twins born at the same time "have *entirely different* careers and destinies." Allow me to remind you of a favorite motto of astrologers: "The wise man rules his stars, the fool obeys them." Astrology merely reveals the influences to which you will be subject, while your destiny depends on the manner in which you react to them. Again: there are characteristics which in themselves are neither good nor bad, but which are capable of being directed into channels either extremely good or extremely bad. Take twin boys born with a keen curiosity concerning sexual matters: One may grow up a "peeping Tom," the detestation of the community, while the other develops into a famous gynecologist. Again: if you regard the opposite careers of twins are arguments against astrology, why should you not consider them as proof that the kind of training a child has is unimportant, inasmuch as two children brought up in the same home often turn out very differently, one being the pride and the other the shame of his parents?

In paragraph thirteen, you argue that if it were forecast that you would die in a railroad wreck on a certain day, you simply would not board a train at that time, and so would prove the fallacy of the prediction by not fulfilling it! The fact is that you would merely prove the truth of another favorite motto of the astrologers:—"The stars incline, they do not compell."

It is undeniable that horoscopes are often unsatisfactory, but this may be explained without reflecting in any way on the scientific nature of astrology. Some are intended only to apply in a general way to those born under a certain sign, and no one with even a rudimentary knowledge of the subject expects them to fit in detail all born under that sign, for the reason that there are many astrological influences besides that of the birth sign that go to the shaping of one's life. Such horoscopes may be compared to a summary of February weather as being cold and stormy, when we all know that it varies greatly according to location, and varies in the same place in different years. Other horoscopes, based on data regarding sex, and date and place of birth, and written by painstaking and conscientious astrologers—note this qualification—contain a great deal of truth. If they also include mistakes, it is not fair to assume that the astrologer is to blame, for they may well arise from inaccuracy in the basic data. If everybody believed in astrology, care would always be taken to ascertain the exact time of a child's birth, but as a matter of fact, the chances are great against one's determining his precise birthdate. You may have been told that you were born "about" three in the morning, but that "about" may allow for some very important change in planetary relationships. Even if you know you were born at just three by the clock, can you be sure that that clock was right? Two clocks in the same house may vary as much as half an hour.

Even correct data would not insure an absolutely infallible horoscope, because astrologers—like all other scientists—continually find they have something yet to learn. Science as a whole is just in the making, and if its usefulness were to

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be gauged by its utter freedom from all error, how little of it would escape the junk heap!

MARIE SNOW.
Tampa, Fla.

(Concerning your statements on Astrology, you have made the assertion that some astrologers count the life of the subject from the moment of conception. How can any astrologer count the influence of the planets from that instant when medical men themselves do not know when conception actually occurs?

You make the assertion that the "wise man rules the stars and the fool obeys them." How can the fool obey anything which does not give him audible commands? How can he obey the stars when he does not know what their influences are, if there are any? We deny the presence of such influences.

We do consider the kind of training that an individual has as being very important in its bearing upon the future life of the child. Two children brought up in the same home turn out differently, not because one is influenced differently by the stars, but because the environment of one of the children is markedly different from that of the other. This will take place even if a family has as many as seven or eight children.

If you have a brother or a sister, you will remember that many times he or she was able to do things which, if you attempted to do as well, would have brought upon you the censure of your folks. You will undoubtedly recall that many times your people showed favoritism toward one of the children in the family. Consequently, the training and environmental stimuli were entirely different in each case.

If the stars rule or control the life of any individual, they must control it in the face of all odds. Your statement that the "stars incline and do not compel" is very much like that famous cross-examination answer, "I don't remember." Neither of these statements mean anything. It is just a way astrologers have of trying to "pass the buck."

You assert that "horoscopes are very often unsatisfactory." Why use the term "very often?" We make the statement that horoscopes are always unsatisfactory, that they are never accurate, and we stand ready to prove this statement. Even those horoscopes written by a college of painstaking and conscientious astrologers and then averaged can not be any more than fifty percent. correct. The average number of guesscs to a given question will always result in approximately the same percentage of accuracy.

Astrology is a very old science. It is older than astronomy, but instead of improving with age, it is becoming worse as the years go along, because now we know which things do influence our lives and we do not follow the sheep at the head of the herd.

Your statement as to whether or not the clock was right when a child was born, may, of course, carry some weight. As far as a difference in clocks of half an hour is concerned, we doubt that such a difference always takes place. It is known that Kaiser Wilhelm II was born at 3 P. M. You don't mecn to infer that the half dozen or more physicians who were at the bedside at the time of birth all had clocks or watches with them which varied as to the exact time of birth?

Also, please remember that even though the planets still hurtle through space at a terrific speed their positions do not vary to such an extent that a difference of a few minutes would be apparent. The exact positions in the heavens could only be calculated, and then the possibility that the planets were miles from this position, due to the length of time which it takes for a light beam to reach this earth from the planets, and also due to possible refraction or bending makes it ridiculous for any astrologer to insist on the time correct to the second.—Editor.)

Editor, SCIENCE AND INVENTION:

The article on "Astrology" in the current issue of SCIENCE AND INVENTION is highly interesting. The following four hundred year old quotation from Luther, in which the Reformer uses very similar arguments against this fake, may or may not be new to you. With characteristic distaste for anything that savored of superstition or trickery, Dr. Luther expressed himself rather feelingly about astrology:

"I praise astronomy and mathematics, which have to do with demonstrations. For astrology I have no respect. I have no patience with such stuff. Let any man answer this argument. Esau and Jacob were born of the same father and mother at the same time and under the same planets, but their natures were wholly different. I caught the Pope by his hair, and he caught me by mine. I married a runaway nun and begat children with her. Who saw that in the stars. Astronomy is very well, astrology is naught. The example of Esau and Jacob proves it."

Such statements of course scandalized Melanchthon, to whom astrology was almost an article of faith.

The translation given is that of Dr. Wm. Dallmann, on page 277 of his *Luther* (Concordia Publ. House, St. Louis, 1917).

ARTHUR PIEPKORN,
Concordia Theological Seminary,
St. Louis, Mo.

(This letter speaks for itself. Need we say more?—Editor.)

(*Continued on page* 751)

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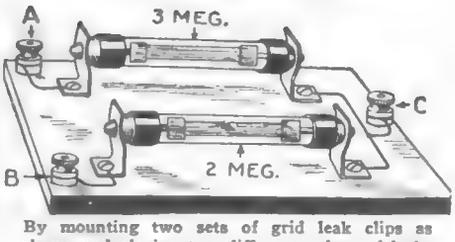

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—Herbert Claybaugh.

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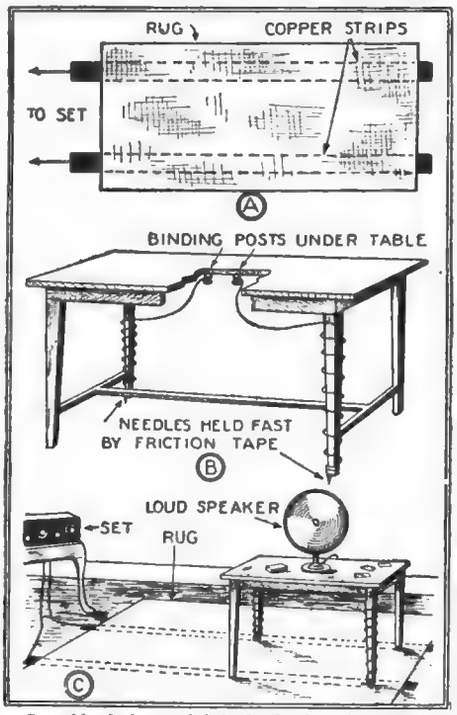

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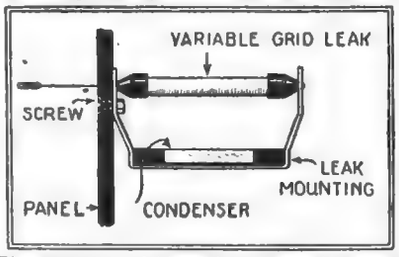
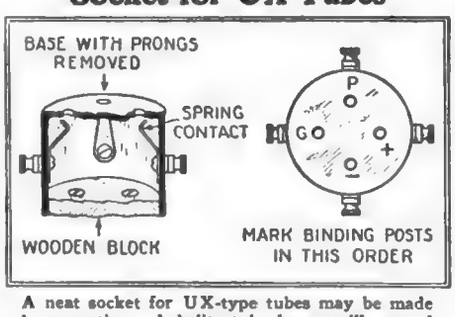


Plunger-type variable grid leak may be mounted as shown to permit adjustment from in front of panel.—Masichi Hori.

Socket for UX Tubes



A neat socket for UX-type tubes may be made by mounting a bakelite tube base as illustrated above.—R. A. Marks, Jr.

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The Astrology Humbug

(*Continued from page 749*)

Editor, SCIENCE AND INVENTION:

I have just read your challenge to astrologers in your October issue, and wish to be sent the data for the three horoscopes. However, in order to cast a horoscope not only the exact moment of birth is necessary, but also the exact place so that one may use the correct latitude and longitude. It is also necessary to know the sex, for the masculine and feminine principal has different rulership. (*This was sent.—Ed.*)

From your experience with so-called professional astrologers, I do not wonder that you are thoroughly disgusted. The sort of astrologers who do not work from an accurate horoscope and who merely tabulate consecutively a series of influences are indeed pseudo-scientists who obviously are preying upon the ignorant public to extract all the money they can. The trouble is not with the science of astrology, but with the interpretation. Since a horoscope is a "map" of a life in all its almost infinite complexity and inconsistency, it is evident that the wisest, most competent astrologer must weigh and balance with utmost care in order to render a judgment which approximates the truth.

Therefore, I am glad to see your offer, for I believe it will bring a response from sincere and competent astrologers who will prove to you and through you to your readers that astrology is a true science.

After completing a scientific college course I looked upon astrology and all kindred subjects with great contempt. So bitter was my prejudice that it required the most overwhelming, repeated, and conclusive evidence to convince me of astrology's truth. Now I know that the astrological influences, that seem so very impossible and absurd can be explained as logically and reasonably as any other of the laws of nature.

Pardon me for saying this, but your discussion of the law of gravitation in connection with astrology exposes your total ignorance of the subject and palpable unfitness to set rules for a contest of its truth. If you, as editor of this contest, are really sincere enough in desiring to find an explanation of the natural law involved to read a short series of manuscripts which will make the principles clear to you, I shall take pleasure in informing you as to where you may secure them at trifling expense.

And don't you think for the sake of fairness you should acquaint yourself with just what astrologers claim to be able to do before establishing rules for your contest? As now stated your demands are unreasonable, particularly those relating to some public event.

A horoscope of an individual merely maps the organization of his sub-conscious mind at the time of birth. Then by progression the major influences that play upon the sub-conscious mind from time to time are shown. These influences set up sub-conscious desires and trains of thought that cause the person to react in certain ways, just as the degree of heat causes us to act in a certain manner. The weather predictions tell us when the day will be hot, but, while, from that one could judge that each person will act correspondingly, could one judge the exact detail of the individual's reaction to the hot day? Will he drink ice-water, seek shade, go to the shore, swim, or what? The horoscope shows the sub-conscious urges stimulated, their combinations, the intensity, and the harmony or inharmony and the departments of life concerned. But it is outside the province of astrology to indicate the exact details in which these definite influences will externalize. The same law holds for public events—the sort of influences operating at a given time are predicted, but to picture the details through which they will work out is impossible, at least to astrologers of this age.

If you wish an example of the practical application of the value of fact obtainable through astrology, you will find it in a very interesting series of articles published in Collier's May 15, 33, 39, 1926. I believe Evangeline Adams, the astrologer who furnished the information, is reliable. Two other New York astrologers whom I believe to be reliable are Kevah Deo Griffis, 45 E. 58th St., and Miss Elizabeth Aldrich, 535 W. 160th St. May I suggest that a personal interview with one of these persons might prove illuminating?— (*It did—see November issue.—Ed.*)

If you and the other editors of SCIENCE AND INVENTION sincerely desire to discover and present the truth instead of attempting to verify your preconceived opinions, I have in this letter indicated the sources through which you may do so.

Whether or not you avail yourself of the opportunity to acquaint yourself with the principles of astrology in a scientific way by securing the brief manuscripts I mentioned will reveal to me and to my astrological associates your sincerity or lack of it.

Believing that you are desirous of presenting the truth, whatever it may be, I look forward with interest to your reply.

MRS. IONE G. WILLIAMS.
San Francisco, Calif.

(*Continued on page 754*)

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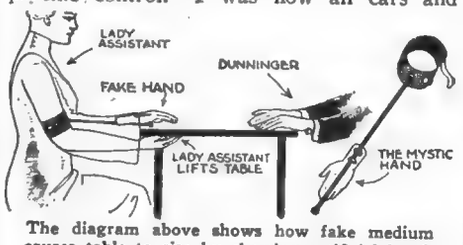
Our Spiritualistic Investigations

By DUNNINGER

(*Continued from page 693*)

tions of the Orient, reflected in bits of ornaments that were scattered artistically about. Upon a slightly elevated platform the Rajah stood, and after inviting all to be seated, the lights were dimmed, save for two lamps in opposite corners of the room.

The subjects of his speech were well chosen, well rendered, and seemed to come from the lips of one entirely sincere. Perhaps this was a complex with our mystic, as his talk was truely convincing. He took pains to explain that delicate subjects were often discussed through the mouths of the dead, and in consideration of the privacy his believers demanded, he did not think it policy to deliver messages in public form. This was his excuse for giving these private seances in individual form. Expecting to see a psychical manifestation, and believing to be in for nothing more than a lecture, I felt a keen disappointment, but this was soon relieved, as the spiritulist announced, that in consideration of the many new faces present that night, he was about to offer a most unusual demonstration in spirit force, by causing a table to levitate in mid-air, by psychic control. I was now all ears and



The diagram above shows how fake medium causes table to rise by showing artificial hand, secured to her right arm by means of the attachment illustrated.

eyes. The attendant brought forth a small bridge table, the folded legs of which were quickly opened, and the table placed in the center of the room. Whether the Rajah was also a student of mind-reading or not, I cannot say, but looking directly at me, he quickly said, "If you are skeptical, you might inspect the table. I would, in fact, appreciate your assistance in this matter if you will." Thanks to this invitation, I at once proceeded to do as he requested, secretly pleased that I had been chosen.

It was plain to see, however, that the table was unprepared, so I pronounced the examination satisfactory, and slowly returned to my seat. "I'd rather you would help me," said the wizard, quickly. "Please bring your chair closer, and seat yourself to the side of the table." I obeyed. "Will two or three other subjects accommodate, and do likewise," came a further request. With little coaxing, another gentleman and two ladies stepped forth. They were seated about the table in a circle, and we were all asked to place our fingers lightly upon the table top. The Hindu placed his hands, to his head, and entered deep concentration. Several moments elapsed. In a soft, distinct tone, and with slow, drawn words, he commanded . . . lift your hands into the air, and in the name of Allah, I command the spirits to use their unearthly influence to cause the table to rise. Slowly the quartette lifted their hands, and the table did rise. Amazement came over the faces of the spectators. Sounds of surprise were murmured, and in dramatic fashion, the medium maintained his pose, as he uttered words in his native language. Lower your hands . . . came the sharp command. We did, and the table slowly followed to the ground. Raise them again . . . he shouted, and once more

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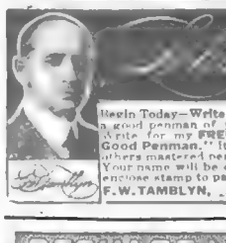

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the table clung to our finger tips, as if some magnetic power had suddenly settled within us, and radiated its force of attraction into this piece of furniture. While all this was going on, I tried to observe things as rapidly as the time would permit. There was nothing beneath the table that would cause this levitation. The knees and feet of the strangers about it were not touching it in any way. There was no evident explanation as to how it might have been accomplished. Silence again prevailed. Slowly the Hindu removed his hands from his face, and with a much exhausted expression, sighed deeply. As if in great effort, he quietly asked us back to our seats, and then uttered another short address, which resembled a good spokesman selling some product or other. We were presently informed that the meeting was over. The spectators quietly arose and many of the newcomers rushed to the Hindu, to shake him by the hand, and congratulate him upon his marvelous powers. There seemed no great haste for anyone to leave, as they all stood about in small groups, exchanging views with one another still apparently impressed with the mysterious spectacle they had witnessed. Observing that Rajah Hassid was busily engaged in controversy, I took this occasion to make my exit, and was helped by the attendant, who politely ushered me to the door. My host left with me.

"Well, Dunninger, what say you now?" he asked of me when we were some twenty feet away from the threshold. An expression of victory o'ercame his countenance. He evidently felt I had been mystified. Such was not the case, however, dear reader, as I at once proceeded to explain to my gullible friend.

The Hindu used a confederate in his work. She was none other than the lady who sat directly opposite me, at the table. I had observed that throughout the evening, she wore gloves upon her hands, which reason is quite apparent. The gloves concealed two artificial hands, which were placed upon the table, and remained in full view of the audience, while her natural hands stationed themselves in firm grip upon the surface below table top, and raised the light piece of furniture into the air, as the Hindu dictated. A smartly tailored dress, with flowing sleeves, was not alone becoming to the charming Miss, but helped well to conceal this action from the spectators, as the flowing sleeve effect covered well the action of her double hands. The angle at which she sat, well away from the spectators, made it quite impossible for all others about to see this, with the probable exception of Rajah Hassid, who stood directly in back of the lady, but knowing well what was taking place had no particular interest in watching the lady's actions. This charming creature must have been the "Spirit Force from the East" referred to so proudly in the medium's slogan.

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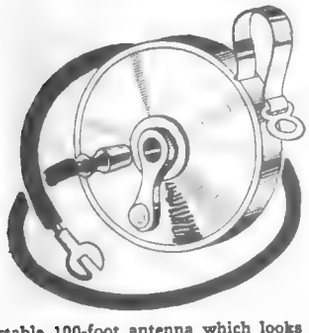

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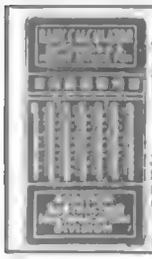

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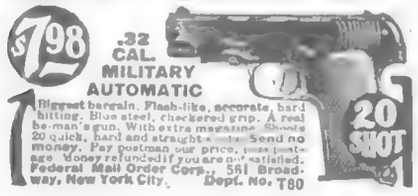

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The Astrology Humbug

(Continued from page 751)

(As in the other letters requesting astrological data on the lives of three individuals, we would advise that we have also forwarded the data to Mrs. Williams.

We do not claim that every astrologer is knowingly humbugging the public. As a matter of fact, many of them believe in astrology and they are absolutely sincere in their beliefs.

You mention in your communication that horoscopes cannot be cast on matters relating to public events. This being the case, your opinion is not in accord with that of other astrologers and certainly does not jibe with published articles in which the astrologers not only forecast the day's lucky hour and the events that will probably happen during the day, but also give forecasts for the week, month and year. Can it be that the astrologers themselves do not know their capabilities?

We thank you for the reference to Mrs. Doris K. Griffis or Kevah Dco Griffis about whom you write that "an interview might prove illuminating." It did. As a matter of fact, it was so illuminating that it was made the subject of an article in the November issue of this publication. You may recall that we sent the birth date of Kaiser Wilhelm to Mrs. Griffis. We also sent her a money order for $25.00, and we received a horoscope which told us that we were the Kaiser's double and told all sorts of remarkable things that were never true. The text of this horoscope is given in the aforementioned article. Possibly after reading this article you will change your opinion as to the reliability of horoscopes as cast by Mrs. Griffis. Whether Evangeline Adams or Miss Aldrich are in the same class probably remains to be seen.—Editor.)

Editor, SCIENCE AND INVENTION:

The attention of the writer has been directed to the editorial entitled, "The Astrological Humbug," and the article "The Truth About Astrology" circulated in the October issue of SCIENCE AND INVENTION.

Enclosed, you will find four blank applications for Astrological analysis, which we ask you to fill out carefully and honestly. I care nothing about the names of your subjects, merely give the initials in the place allotted to names, but be careful to fill in the remainder under the caption "Information," except that if the minute of birth is in each case known, the personal description may be omitted. Be certain to give the sex of your subjects and incidentally, the dates of death.

You will find enclosed a self-addressed envelope for the return of these blanks, properly filled out.

In addition to your three test cases, kindly give the following, in regard to your subject, Florence B., born January 1st, 1889, died January 2nd, 1919, and on which you dishonestly trapped some practitioners, whether they were honest or otherwise is beside the question (*sic.*) The point that I am raising here is that in your zeal to discredit something of which you are evidently ignorant, you resorted to and employed dishonest and dishonorable methods.

Kindly fill out one of these blanks for Florence B. in full, being careful to give me the residence of the Mother nine months previous to birth. I would like you to interyjew that Mother, as also the Mothers of all your subjects, and ascertain whether the periods of gestation were normal, long or short, whether the deliveries were natural or forced, or delayed, as this information is necessary to the work before us.

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Congratulating you on your very able efforts in eliminating the frauds and charlatans from (we hope) all departments of science, and thanking you for your kindly attention to the requests herein made, I remain

DR. CHAS. A. LOGAN,
Fairhope, Alabama.

(This is the information we are requested to give.)

Name in full ..... Race .....
Date of birth .....Place of birth .....
Time of birth—hour ..Minute....A.M. or P.M...
Type of birth—normal.....Surgical.....
Prenatal term—normal.....Short.....Long.....
Mother's residence at time of conception.....
Personal description—Photographs are helpful where they can be lent.
Height .....Weight ..... Built—Slight.....
Medium.... Heavy Flesh—Firm..... Soft.....
Muscular .....Wiry .....
Complexion Ruddy...Pale...Dark...Freckled....
Arms and legs—Long....Short (in porportion to body) .....
Eyes—Color .....Shape—Round.....Oval.....
Small .....Large .....
Set straight.....slant.....Close together....

(Continued on page 758)

Tom Sawyer's Coming Back

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Huck Shows Tom the Dead Cat

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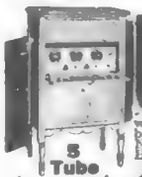

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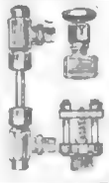

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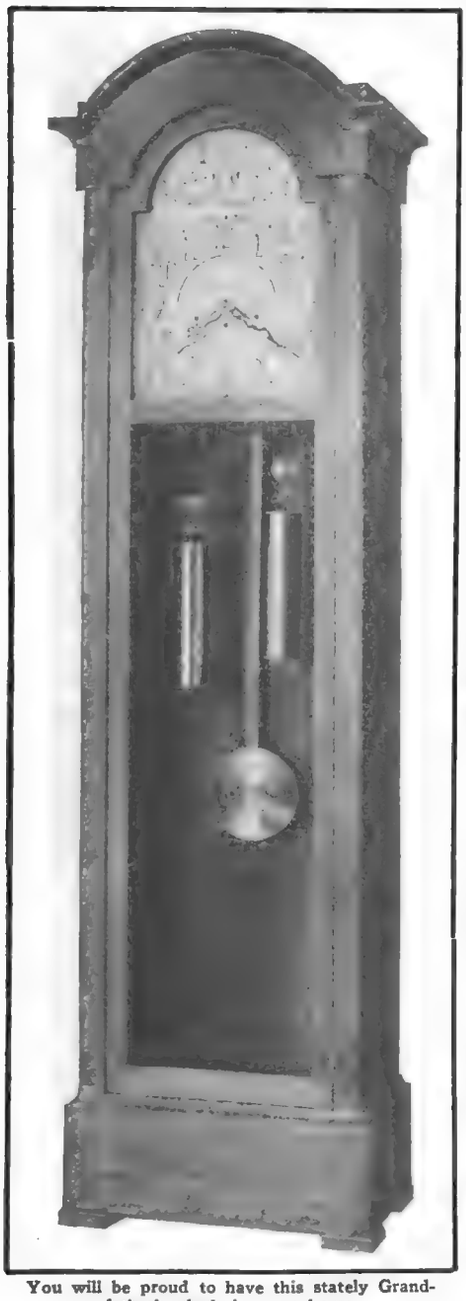
BUILD YOUR OWN GRANDFATHER'S CLOCK

By LOUIS A. BREITINGER

UNTIL recently many homes in which a Grandfather's Clock would be warmly welcomed, were necessarily deprived of having one by reason of their prohibitive cost; but to those who have the knack of building things and the patience and skill to stick to a job until it is finished, the opportunity of building a Grandfather's Clock is hereby presented. Many handy men will not merely build a clock for their own use, but build others for profit.



You will be proud to have this stately Grandfather's clock in your home.

The drawings and explanations given should be gone over very carefully before starting the work. The sizes given in the stock schedule are nearly all finished sizes.

Waist sides should be planed straight and square to a length of 68 inches and width of 10½ inches.

Pilasters are 68 inches by 1¼ inches, planed straight and square, glued to the waist sides as seen in sections AA and BB; use lots of clamps, and see that the joints are up good and tight before gluing. Rabbet out the back edge of each side to allow the back to be set in.

Turn 1 Dial—get stations everywhere:—30 Days Free!

SEND COUPON FOR AMAZING SPECIAL OFFER!

NOTE: This offer is made to prospective buyers by famous big Radio Corporation, one of America's oldest reliable manufacturers of fine sets—seventh successful year. Many satisfied users in every state. Postal or coupon brings testimony of nearby users and proof Miraco's outperform sets costing up to 4 times as much. Very easy to operate

BEAUTIFUL-BIG-POWERFUL Ultra Selective MIRACO Unitune 5

Beautiful Hand-rubbed Solid Walnut Cabinet

28 in. Long

Built to look like and perform like a $200 set. Users report:

MIRACO RADIO GETS 'EM COAST to COAST

Send for proof!

ONE DIAL CONTROL Only One Dial to turn for all programs.

Sent on 30 Days Free Trial. Enormous demand for Miraco 5's makes possible bosts of costly new refinements and improvements at lower prices than ever. Genuine Bakelite sloping panels, dials beautifully finished in walnut to match cabinets; Connect-E-Z Battery Cables; features (too numerous to mention) of high-priced sets. Send for Amazing Low "Unitune" Price

SPECIAL WHOLESALE PRICES to user-agents who show the set to friends. DEALERS WRITE!

Yes!

Users report Miraco Radios get programs Coast to Coast, also Canada, Cuba and Mexico, loud and clear on speaker; outperform $100 to $200 sets. Some have heard Europe, S. America. Don't confuse Miraco with small cheap sets. Unless trial proves it MOST SELECTIVE, CLEAREST TONED and MOST POWERFUL DISTANCE-GETTER among beautiful big 5-tube sets, don't buy it. Every Miraco comes completely assembled, rigidly tested and fully guaranteed.

Our Factory Prices Save You Up to ½!

SEND NO MONEY! Save or make much money on sets, speakers, tubes, batteries—write for AMAZING OFFER. Ultra-5 (not illus.) is marvelous value in a big Guaranteed 6-tube, 3-dial set: Ultra-5 $49.75 Retail List

COAST TO COAST RECEPTION verified by Miraco users

Reports from users everywhere leave little for us to add. These are only a few of the many in our files and which we receive daily. Send coupon for plenty of additional proof, testimony of nearby users and SPECIAL OFFER

"UNITUNE" SEPARATES CHICAGO LOCALS. Chicago. With 4 stations broadcasting less than a mile away, one after another I can tune and keep separated as high as 15 Chicago stations on your "Unitune-5". Even during the summer I frequently get stations clear and loud on speaker as far away as Colo., New Jersey, New Orleans and many others. With the single dial I switch from one to another station in an instant. The selectivity is amazing, the set is a beauty and the tone is perfect. W. H. Schaeffer.

COAST TO COAST THROUGH LOCALS Omaha, Nebraska. Miraco is a wonder for distance, volume, tone. We have 5 local broadcasting stations here and she goes right thru and brings them from coast to coast. No trouble at all. H. N. Eller.

BEATS OTHERS FOR SELECTIVITY. Cleveland, O. Have been up against some pretty good radio men with other sets and this receiver has them guessing. In selectivity, volume and range it has outdone several. We were able to cut out WTAM (powerful local station) in 3 points, to bring in other stations. W. C. Pike.

HONOLULU TO LONDON FROM IOWA. Anthon, Iowa. Here are some of the stations we picked up on the Miraco 5 Sunday Jan. 24 between 10 and 11 P. M.: 2LO London, KYO Honolulu, Hawaii; WKAQ San Juan, P. R. and a station in Ireland; could not get call letter. John Kuhn.

NEW YORK LOGS 163 STATIONS Ruffalo, N. Y. I received 2LO London, 11:05 on Monday night but there was so much interference it was not very plain. I also logged 163 stations in U. S. and Canada. Satisfied user of Miraco. Norman W. Ives.

NEBRASKA HEARS PORTO RICO ON SPEAKER. Spencer, Nebraska. Using the Miraco 5 we have often heard Mexico City, Porto Rico, Miami, Florida, Ottawa, Canada and Vancouver, B. C., Canada and all along the Pacific Coast. All the above stations on the speaker. Have also heard Lima, Peru, South America. H. J. Schmidt.

TONE, VOLUME, DISTANCE. Elbing, Kans. We like our Miraco fine especially because of its volume, tone and its freedom from howling. Although I do not try much for distance we received programs from Oakland, Cal.; Los Angeles, New York, Miami and Havana. In my opinion it's the best ever. Mrs. E. A. Regier.

MIRACO EQUALS $240 SET. Omaha, S. D. Miraco works fine. Selective and plenty of volume. Stations logged include Winnipeg, Canada; PWX, Havana, Cuba; and CYL, Mexico City, Mexico. Have heard quite a few sets, one costing as much as $240, but can't see where it is any better. Clarrence Rusch.

NO HOWLS—SUPERIOR TO COSTLY SETS. Modoc, Ind. We certainly enjoy our Miraco-5. Results equal to any radio I ever heard and far superior to most radios costing a great deal more. All stations come in loud and clear on the loud speaker. James Tullis

OUTPERFORMS 6 AND 8 TUBE SETS. Duncanaville, Pa. I don't think there is a better receiving set made than a Miraco-5. Stations received—all on the loud speaker—include KFI, Los Angeles, California—distance, 2,250 miles. I get this on loud-speaker plain, when others couldn't get it with 6 and 8 tube sets. Also have heard Can., Colo., Fla., Cuba, Neb. and many other states. S. D. Fowkes.

CALIFORNIA HEARS PENNA. ON THE SPEAKER. San Rafael, Calif. I have purchased three of your sets and will give you an idea of what the Miraco-5 does out here. I have logged 86 stations, which I can get nearly any time I try. Mexico City on the South to CFCN, Calgary, Canada, on the North, with Honolulu to the West and E. Pitts., Pa., to the East. All on loud speaker, clear and plain. Roy I. Sharer.

MIDWEST RADIO CORPORATION, Pioneer Builders of Sets
409-P Miraco Bldg., Cincinnati, Ohio
WITHOUT OBLIGATION, send free literature, AMAZING SPECIAL OFFER, testimony of users, etc.

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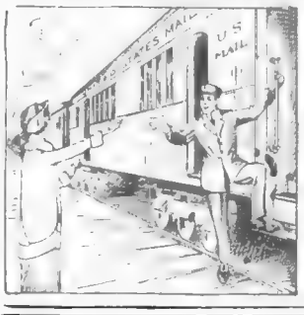

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Results guaranteed or money refunded.
PRICE 50c. POSTPAID

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Fun with these never ends, try them on the grocer, the street car conductor, your friends and watch their faces—keep a few on hand always.

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Pull the trigger of this
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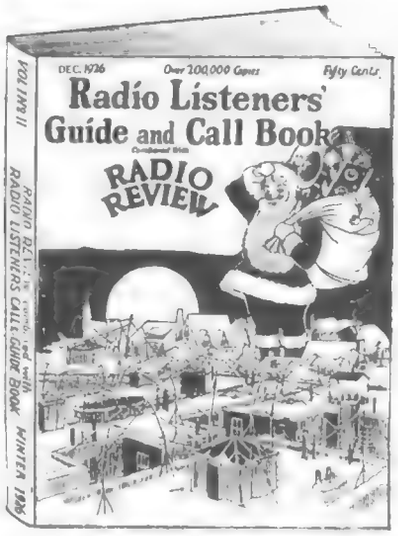

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The lower front rail is 16 inches by 6¾ inches. This is made of poplar with the top edge of mahogany. Dowel the rail to the sides with two dowels in each end. Use a screw between the dowels to draw the rail up to the pilaster.

The base may now be moulded on the upper edge and scalloped on the lower. Glue and screw around the waist sides. Miter the front piece first, glue that in place and fit the side returns to it. Size the miter joints before gluing to prevent the glue working away from the joints. The bottom, made of poplar, should now be screwed in place, as it will help to strengthen the base. See that everything is straight, plumb and square. Screw a strip across the top on the inside of the pilasters to hold the sides temporarily until the hood is fastened.

The hood-front should be made up of two pieces, the front of mahogany 20½ inches by 10½ inches by 1 5/16 inches; the second of poplar. This piece should be as long as the distance between the waist sides on the inside, 10½ inches wide, 13/16 inch thick, and must be square on the end, not mitered. Miter the front piece and glue on the second. Miter and fit the hood returns, which are 11 7/8 inches by 6 inches by 1 5/16 inches. Rabbet out the top and back edges for the top and back to set in. Lay off the 6¾ and 11¾ circles, bandsaw to the line and smooth up with a sharp spokeshave.

Care should be taken in clamping the hood returns to the front, not to draw too hard on the clamps, as the circle may be contracted and held there after the glue has hardened. Size all miter joints before gluing. The hood and arch moulding is to be laid out on a piece 24 inches by 8 inches by 1½ inches, and moulded at the mill. The returns may be worked in one piece 28 inches by 2 inches by 1½ inches.

The front moulding should be mitered and glued in place.

Care should be taken to have everything square and all joints tight, as any imperfection will show up badly.

Dowel the hood to the waist sides and fasten with hooks, so that the hood may be removed to place the works in position. The door is to have all joints strongly mortised, the tenons should not go all the way through the stiles, as they would not look well if exposed.

Rabbet the inside edge of the door for the glass. The arch rail should be cut at the mill.

In gluing and clamping the door, have it on a level surface to avoid having a twist in it, and be sure that it is square. The door sits back from the pilasters 3/8 of an inch, and three extra wide hinges should be used to swing it clear of the hood and pilasters.

Rabbet strips should be screwed on the inside of the pilasters to allow the door to shut against—two on the sides from the middle rail down (see sec. BB), and one across the bottom; two on the sides from the middle rail up for the dial frame to rest against (see AA); the arch circle furnishing around the arch.

The dial frame is intended to hold the dial and should fit the hood and sides neatly. The joints should be strongly mortised. The back may be made of poplar and either paneled or in one piece. Panelling is to be preferred as it takes care of the expansion and contraction. In panelling make the lower panel extend to the middle rail of the door. The top and back should be screwed in, not glued.

Finishing—Scrape well with a sharp cabinet scraper and sandpaper with the grain, using No. 1 and 0 sandpaper. Be careful to select a good mahogany stain, only a penetrating or water stain should be used. Do not use stain that contains varnish. After scraping and sandpapering, sponge the wood lightly with clean, hot water containing about a tablespoonful of glue. Allow this to **dry**

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Or do you only think you do?

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Do you **know** when you make mistakes?
You cannot **afford** not to know your own language.

DO YOU SAY—in'kwirry for ing'ui'ry; ad'dress for address'; cu'pon for cou'pon; press'dence for prece'dence; hydth for height; conver'sant for con'versant?
DO YOU SAY—between you and I; a raise in salary; a long ways off; a setting hen; let's you and I go somewheres; those kind of men; that coat sets good; he don't know as he can; a mutual friend; refer back?
DO YOU KNOW WHEN TO USE—sits or sets, laying or lying, farther or further, drank or drunk, who or whom, I or me, lunch or luncheon, affect or effect, council, counsel or consul, practical or practicable, admittance or admission, shall or will?

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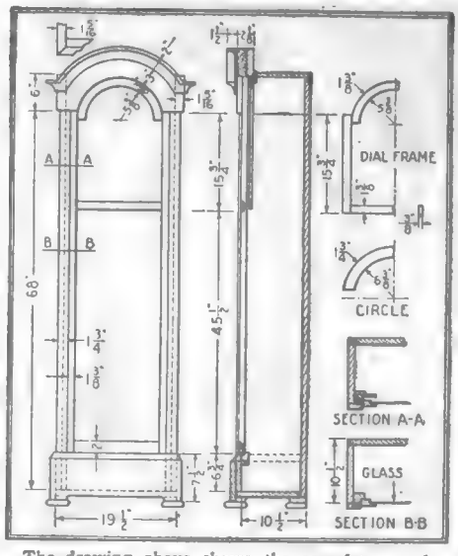

The drawing above shows the complete wood frame of the grandfather's clock here described.

about 24 hours, and sandpaper with the grain, using No. 00 sandpaper. This will keep the grain from rising after staining.

Try staining and filling a piece of mahogany before attempting the clock case, so as to get the desired shade. After the stain is applied and given 24 hours to dry, sandpaper lightly with No. 000 sandpaper, taking care not to cut the stain, after which give a coat of filler. This should be well rubbed off after setting a few minutes. Use a piece of burlap, rubbing across the grain.

Allow the filler to dry for about two days, then sandpaper lightly with 000 sandpaper, clean off with a woolen rag and give a thin coat of orange shellac. This will dry within 24 hours, when it should be sanded with a fine paper and given a coat of the very best cabinet varnish. This should be flowed on with a fine brush and allow to dry from 4 to 5 days. It may now be rubbed down with fine pumice stone and water; care should be taken not to cut through the varnish into the bare wood. Clean off the water and after the work is thoroughly dried, give another coat of varnish. Let this dry as before and rub with rottenstone and oil, cleaning and finishing with a soft woolen cloth.

An enterprising clock manufacturing concern has for some years been specializing in the business of furnishing clock movements, dials, chimes, gongs and parts for amateur clock builders, also some of the more difficult parts of the cases as well, the special hardware and the finishing material needed. The name of this concern may be obtained from publisher or advertising columns.

STOCK SCHEDULE

2 Waistsides, 68 by 10½ by 13/16.
2 Pilasters, 68 by 1¾ by13/16.
1 Bottom Rail, 16 by 6¾ by 13/16.
2 Door stiles, 64 by 1¾ by 13/16.
1 Head rail, 15 by 7 by 13/16.
1 Middle rail, 15 by 1½ by 13/16.
1 Bottom rail, 16 by 2 by 13/16.
1 Base, 47 by 7½ by 13/16.
1 Hood front, 20½ by 10½ by 1 5/16.
1 Hood front, 17⅞ by 10½ by 13/16, poplar.
2 Hood returns, 11⅞ by 60 by 1 5/16.
1 Arch moulding, 24 by 8 by 1½.
2 Arch moulding returns, 14 by 2 by 1½.
1 Dial frame (see drawing).
2 Rabbet strips, 15¾ by 1¼ by 1¼.
2 Rabbet strips, 47 by 1¼ by 13/16.
1 Rabbet strip, 20 by 1¼ by 13/16.
1 Dial circle (see detail).
1 Back, 75 by 19 by ¾, poplar.
1 Bottom, 18½ by 10¾, poplar.
1 Top, 18½ by 9¾ by ⅜, poplar.
3 special hinges.
1 mortise lock.

TOOL LIST.

The tools required in building this grandfather's clock include hammer, coarse and fine carpenter saws, hand drills, files, rasp, rabbet planes, wood chisels, gouges, carpenter's finishing plane, screw drivers and twist drills, and scriber.

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Builder of Men

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You're Worried—Your Pep Is Gone!

You awaken in the morning all tired out, sluggish, nervous, constipated, dizzy, with headaches and a nasty taste in your mouth. Your cheeks are sallow or sunken. Your eyes—black rings under them, bloated, bloodshot, and burning—in other words, you are bleary-eyed. You go to your work, not with energy and ambition, but with a slouch and a grouch. Work drags. Your head is befogged—you can't think straight. You feel miserable. You are wretched.
Why is it? Ah—you are paying the penalty for those wild days of youth. The terrible mistakes you then made, the terrific pace at which you traveled, the awful abuse of your body, have come in for a reckoning.

I Restore Your Health, Your Strength!

No matter how far down you have gone, I can and will help you. Only give me the chance. I am your friend, holding out my helping hand to you. I don't care how serious your mistakes of youth were, how much you dissipated, or how badly you abused your body. I don't care how miserable and wretched you are now—how weak and sickly—how wasted—I can and I will help you.
I will build you up inch by inch—internally and externally—until you are a robust powerful fellow—a real He-man who will command respect and admiration wherever you go. I have done this for thousands of others and I will do it for you through my original and unfailing methods of

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The Astrology Humbug

(*Continued from page 754*)

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Wavy .....Straight .....Early baldness in men? .....
Teeth—Regular .....Irregular .....Pointed
cusp teeth..... Front teeth separated?.....
Sound..... Subject to decay .....
Nose—Large .....Medium .....Small .....
Straight .....Aquiline ..... Hump .....
Irregular .....
Ears—Hearing good .....Poor .....Deaf .....
Throat—Long .....Medium .....Short .....
Any goitre trouble? .....Give date .....
Size of shoe..... Size of glove.....
Birth marks—Color .....Size .....Location.....
Sex ..... Occupation .....
Dates—Marriage .....
Children .....
Important journeys .....
Illness or operation (please describe).....
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In filling out this blank, the dates of events are not so necessary if you have a correct birth time. If it is not certainly known, then all the items you care to give are needed to arrive at your correct time.

Please indicate carefully just the sort of work you want done, fill out the blanks, and return with check. You will probably have your work within two weeks, unless some condition exists which makes for delay—in which case you will be notified.

If the delay interferes with your plans, your money will be promptly returned. Address all inquiries to DR. CHAS. A. LOGAN, *Drawer F,* Fairhope, Alabama.

(We shall be glad to give you permission to republish the article on astrology in SCIENCE AND INVENTON *Magazine and make any comments thereto that you care to, provided that you give this publication credit and also with the hope that you will send us a marked copy of the magazine or pamphlet in which this is reproduced. Inasmuch as the writer was intimately acquainted with Florence B. for many years, he is able to state with a fair degree of accuracy that there was absolutely nothing abnormal in either the period of gestation or the delivery.*

What is there that is dishonest and dishonorable in sending for a horoscope of a departed friend to see if an astrologer knows his business? If the astrologer had sent us an accurate horoscope would it have been honest? Was the forecast of the Dempsey-Tunney bout dishonest because it proved a fizzle and resulted in a negation of the astrologer, Prof. Gustave Meyers' calculations? Was the analysis by Dr. Lillian L. Houghtaling on the Wills-Sharkey prize-fight obtained dishonestly? Why should both winners have held the worse horoscopes? Why should horoscopes favor the same individual upon whom betting money is placed, at odds in the first case of as much as 6 to 1 just before the fight and in the second at 3 to 1. Why should the astrologer's honesty be "beside the question."

Code initials of three men and birth places as well as dates and times were then given. Dr. Logan did not request a check for drawing up an astrological chart. We merely republished his printed form above.

Inasmuch as the questions concerning life or death, the nature of the teeth, the height, weight and build of the individual or the complexion of the person are supposed to be ruled by the planets, we are omitting this information for the present. The individual's occupation is also not given.—Editor.)

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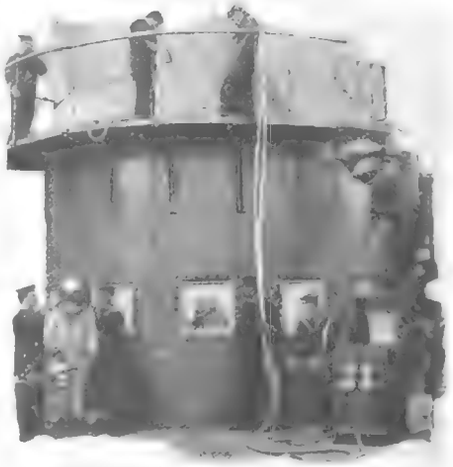

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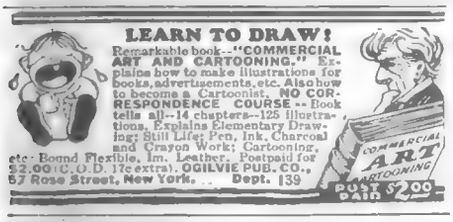
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Wirekraft—A New Art

By HUGO GERNSBACK

(*Continued from page 688*)

wire for the purpose may be bought at most hardware, radio and electrical stores, but if you can not secure the right size of wire, a stamped addressed envelope sent to the Editor of Wirekraft Contest will bring you the information where this wire can be secured in your vicinity.

TECHNICAL DATA ON WIREKRAFT

Wirekraft is a simple craft and requires no great amount of skill. Any one handy with a pair of pliers and a soldering iron can build Wirekraft articles. Here are a few simple rules that should be observed in Wirekraft building:

STRAIGHTENING OF WIRE.

Most wire comes in spool form. Wire as wound on spools usually does not come off straight. In Fig. 7 is shown one simple way to straighten the wire. Simply drive three nails along a straight line into a piece of board. Run the wire in and out between the nails, and now when you pull you will find that the wire comes off straight. By placing the nails in correct position, best results are obtained.

After being straightened, the wire can then be cut into the required lengths, all depending upon what lengths are needed. In Fig. 6 is shown a form for bending the wire after it has been straightened, where a great

(*Continued on page 761*)

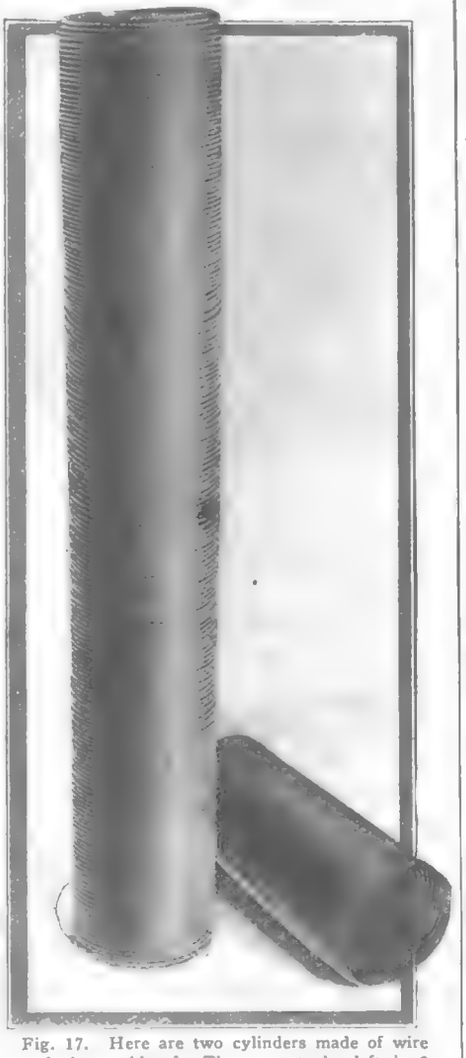

Fig. 17. Here are two cylinders made of wire and then soldered. The one at the left is 3 feet long. It is obvious that the diameter could have been much narrower and that a tube of this nature can be employed in a variety of different ways.

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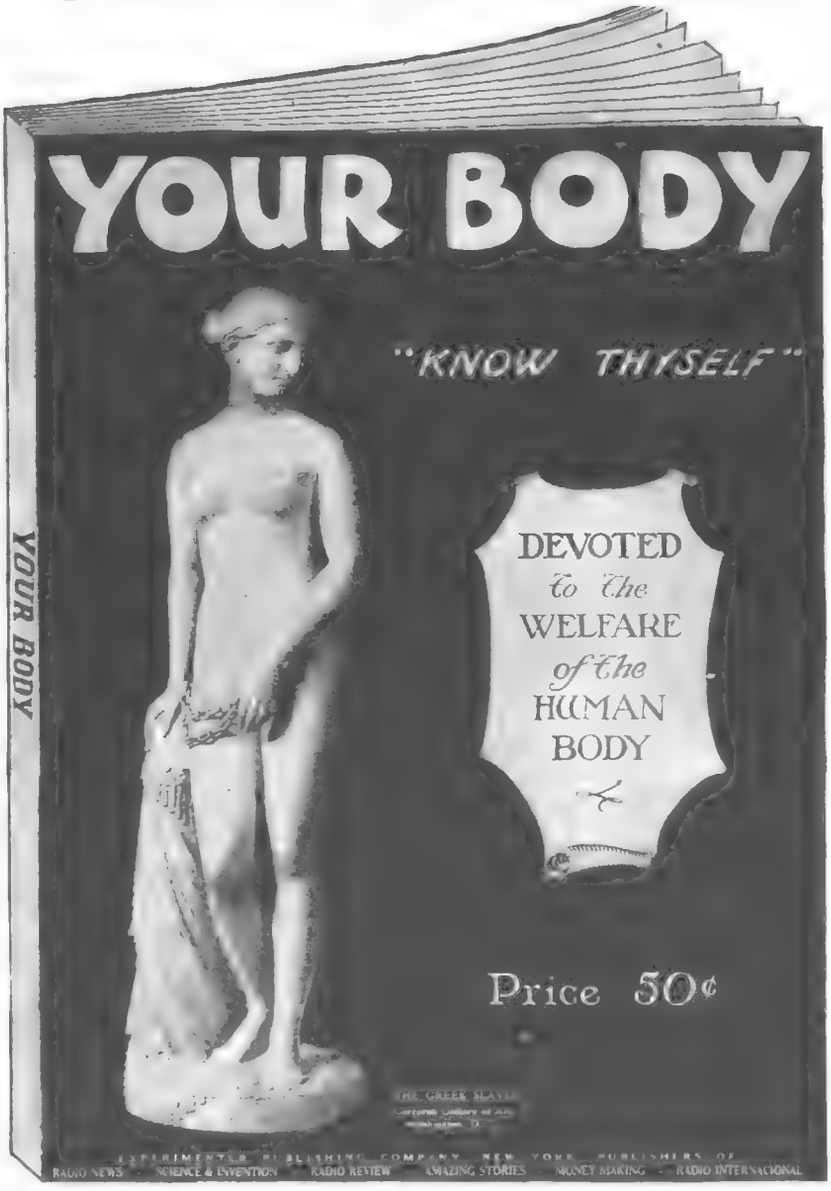

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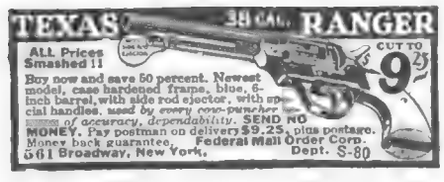

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Wirekraft,—A New Art

(*Continued from page 759*)

number of wires have to be bent in a certain shape. Wire can also be bent and shaped by means of round-nosed pliers of small circumference, or else it can be shaped by wrapping the wire around drums or prepared wooden or metal forms. Heavy wire can be hammered into shape by using a vise, which can be fitted with extension blocks of suitable shape, if many heavy wires are to be thus bent.

Fig. 18. A convenient form of wire can be obtained on the market in spools which are provided with metal stops and which hold the wire in place on the spool after it is cut. With this type of spool it is quite impossible for spring wire to slide off its holder.

The method of straightening wires shown in Fig. 7 is not advisable when the wire is thicker than No. 12 B. & S. gauge. In that case it is best to cut the wire to size and use a hammer or a piece of wood to straighten the wire, first giving it rough straightening. Then it can be made absolutely straight by placing the wire between two pieces of thick board and rolling the cut wire between the two boards, applying pressure to the top board. It will be found that the wire rolls easily back and forth until a perfectly straight piece of wire results. If a great number of heavy wires are to be straightened in this manner it is advisable to use iron plates, as the wood will not stand up for any great number of wires and will become badly dented and broken up.

FASTENING WIRES TOGETHER

Various methods can be used in Wirekraft to join wires together. This may be done either by soldering, spot welding or wrapping thinner wires tightly around two adjoining wires. The mechanical joint can be held together simply by the wrapping, or, to make it stronger, by soldering the wrapped wire. Adjoining wires may also be twisted together, or spliced, or held together by some sort of metal fastener. Any and all of these methods may be used, whichever is the most practical and suitable for the purpose. In most cases, however, ordinary soldering may be used.

At this point we wish to state that wherever soldering is done, flux solder should be used. Never use acid, as sooner or later the joint will corrode. Soldered connections with flux can be wiped clean and will last for years.

Be sure, when soldering, that you have a good iron, and be doubly sure that the point is nice and clean, because you can not make

(*Continued on page 763*)

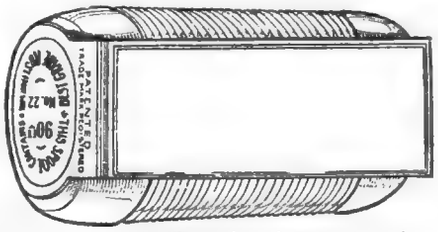
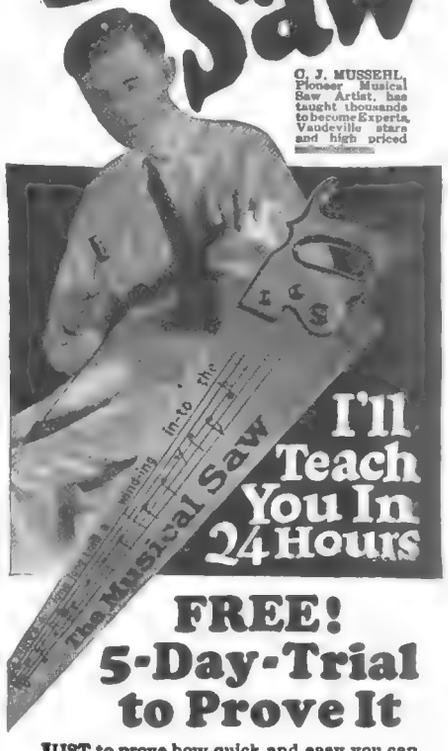


Fig. 19. This illustration shows a top view of the patented wire holder found on some spools of wire.

Play a Saw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Wirekraft—A New Art

(*Continued from page 761*)

a perfect joint with a dirty iron. If you have had no experience in soldering, any tinsmith will show you how to do it, or you might experiment a little yourself. You should be able to master the art of soldering within an hour by trying different materials. Always remember, when soldering, that no good joint can be made unless the articles to be joined are clean and tinned first. For instance, iron wire will not solder unless the wire is first tinned. The tinning is done by running the solder with the hot soldering iron, using a good flux, around the clean iron wire, and then letting the wire and solder cool. Two articles thus treated can easily be soldered afterwards.

Remember that in soldering, success can only be had when the articles to be joined are perfectly clean. Copper, brass, and iron wires can not be soldered well unless they are scraped metallically clean. Wires can also be spot welded. This spot welding requires electricity—a storage battery or transformer is preferred.

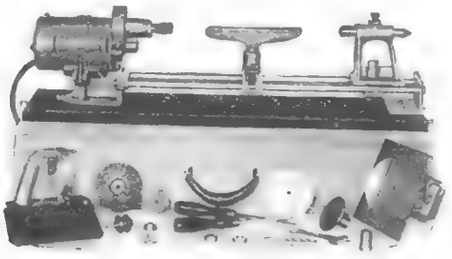
A small alcohol or gasoline blow torch can also be used in lieu of a soldering iron, but the danger here is that the whole contrivance will get so hot that other joints already soldered may become unsoldered, due to the heat. With the soldering iron there is no such danger unless the wires are very closely adjacent, in which case they should be cooled by a wet rag or water so they do not come unsoldered.

Cylinders of any size and very solid can be fashioned by winding the wire on either cardboard, wooden or iron cores, or even bottles. While still on the form, a straight line is scraped or sandpapered up and down the entire cylinder, when the various wire convolutions can then be soldered together. If soldered at four points around the circumference, you will have a very solid cylinder after you take it off the form. Such a cylinder can even be made waterproof by soldering every point of contacting wire. Usually tacking a straight strip of solder straight up and down the cylinder will hold it together and make it a workmanlike job. Cylinders thus formed in our Laboratory are shown in Fig. 17. After sandpapering the soldered joint smoothly, and after the article has been painted, it is quite impossible to detect the soldered joint.

TOOLS

Wirekraft does not necessitate expensive tools. A pair of good shears, several pairs of pliers—round nose, flat nose, and side cutters—a good soldering iron, solder, flux, a good vise, small hammer, a few boards, and maybe a steel plate or two (the latter to be used in straightening out wires) are all that is needed. You will be surprised to see what wonderful models and articles you can build with just these few tools and a few spools of wire. Nor is the work very intricate or hard. The more Wirekraft models you build the more interested you will become in this new art, which should prove of great interest to all those handy with their hands and those who wish to fashion things themselves for the pleasure and instruction gained thereby.

During the coming months you will be astonished at the tremendous variety of articles that can be fashioned from wire. Thousands of dollars in prizes will be awarded, and the sooner you start, the quicker you will win a prize.



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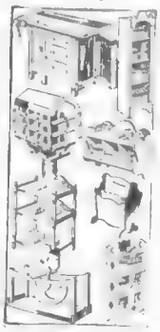

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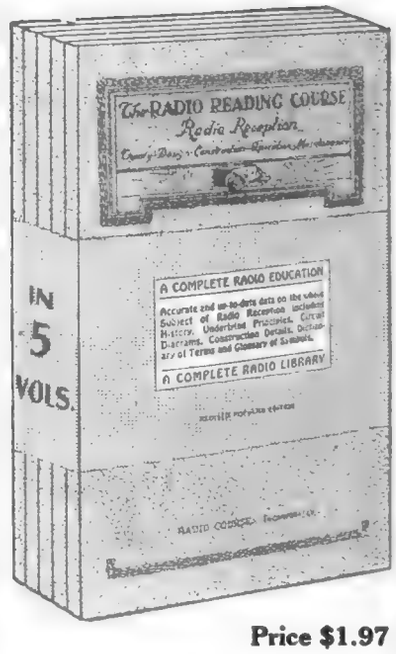
CARBON IN AUTOMOBILE CYLINDERS

Some very exhaustive tests have been made to determine the causes of the deposition of carbon in automobile engines and to ascertain or discover the means of preventing it. It might be attributed largely to a deficiency of air, but this is a minor trouble, as is also the cooling effect of the mass of iron in the cylinder and cylinder heads. These causes operate to prevent complete combustion. It is quite possible that sufficient air to burn the gasoline completely and perfectly may be in the mixture, and yet the cooling effect of the cylinders acts to impair the combustion. It has been found that various substances can act as catalyzers and separate the undesirable carbon, but to determine the definite cause of the deposition has not been so easy. The Bureau of Standards and the Bureau of Mines, both federal organizations, have found that it is very difficult to draw reliable conclusions. With the utmost care they were unable to get two runs of an engine apparently under similar conditions to show the identical or relative deposition of carbon. This is laboratory work, and on the road no such identical conditions can be established, and the problem is much more complicated. However, it was tried on the road with changing about of chauffeurs to eliminate the personal factor. Four new automobiles were driven twelve thousand miles without any consistent results, but at last by applying refinements to the test some very tangible results were obtained.

Whenever oil appeared on the heads or on the pistons, carbon was formed, as might have been expected. Variations in the kind of oil used in the gasoline and the temperature of the cooling jacket and other factors influenced the depositon. Eventually a more or less definite conclusion was reached that carbon deposition was intimately connected with the amount of oil that found its way in above the pistons into the combustion chamber. With bad or broken piston rings gasoline would find its way into the crank case, and oil on the intake stroke would be drawn up above into the combustion chamber and would spray all over the walls. The vacuum on this stroke may amount to as much as twenty-five inches of mercury. It follows that the piston rings should fit very well, but this is not all. They do not act only by their fitting, but oil accumulates around the back of them, so that what is known as an oil-seal is formed, and this is a very critical thing, and its maintenance has a great effect in preventing the deposition of carbon.

Tests were made under conditions which practically prevented oil getting into the combustion chamber. Analysis of the exhaust gases showed imperfect combustion, but with a very rich mixture, there was very little carbon deposited after the first twelve hours. Economy dictates the importance of perfect combustion, but oil seems to be the criminal when it comes to the depositon of carbon. Without giving the exact figures reached, it was found that the major factors of carbon deposition in an automobile engine are: (1) The amount of lubricating oil projected into the combustion chamber. This is by far the greatest factor. (2) The kind of oil used. (3) The temperature of the combustion chamber. (4) The extent of time the preceding factors have been in effect. The general result is that in practice, which means on the road, oil cannot be kept out of the combustion chamber and carbon will be deposited. The data are taken from a paper by J. W. Orelup and O. Ivan Lee, the latter a familiar name to our readers. (Reprinted from *Industrial and Engineering Chemistry,* Vol. 17, No. 7, page 731.)



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Why Florida Hurricane Occurred

By E. B. "FARMER" DUNN.

(*Continued from page* 683.)

it steadily increases and becomes brisk. The barometer begins to fall, while black, threatening clouds darken the horizon and rapidly cover the upper sky. Rain suddenly falls in torrents, the wind screeches and howls, lashing the waves of the ocean into a menacing sea. On land there is a weird and torn mass of wreckage. The hurricane has arrived in full force. The more furious the storm the quicker it passes, and the more rapid the rise in the barometer the harder the wind blows after the center has passed.

Hurricanes have been more numerous this season than for many years. No less than three have been in operation at one and the same time during the past month.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

Of SCIENCE AND INVENTION, published monthly, at New York, N. Y., for Oct. 1, 1926.

State of New York)
County of New York) ss.

Before me, a NOTARY PUBLIC, in and for the State and county aforesaid, personally appeared HUGO GERNSBACK, who, having been duly sworn according to law, deposes and says that he is the EDITOR of SCIENCE AND INVENTION, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, EXPERIMENTER PUBLISHING CO., INC., 53 Park Place, New York, N. Y.

Editor, HUGO GERNSBACK, 53 Park Place, New York, N. Y.

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2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent. or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

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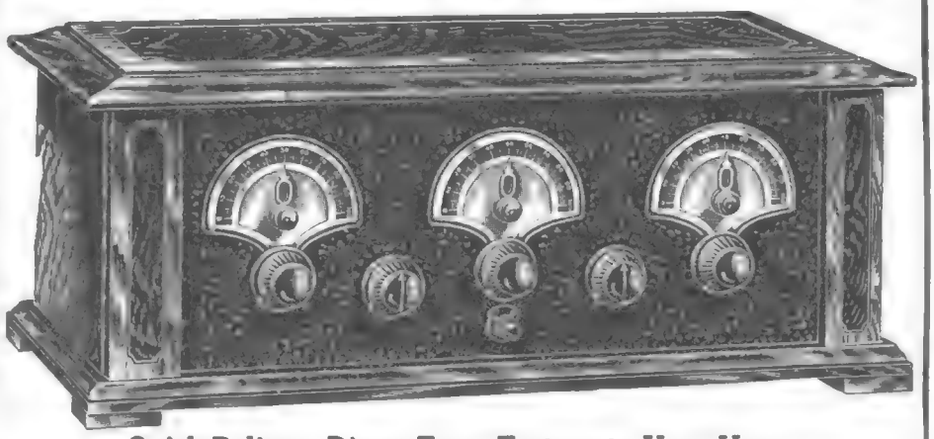

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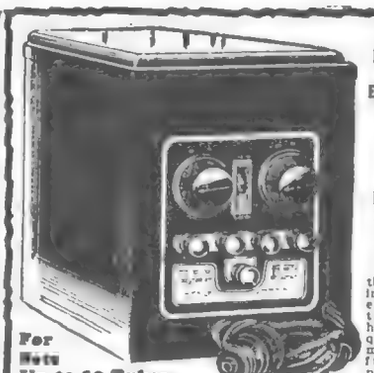

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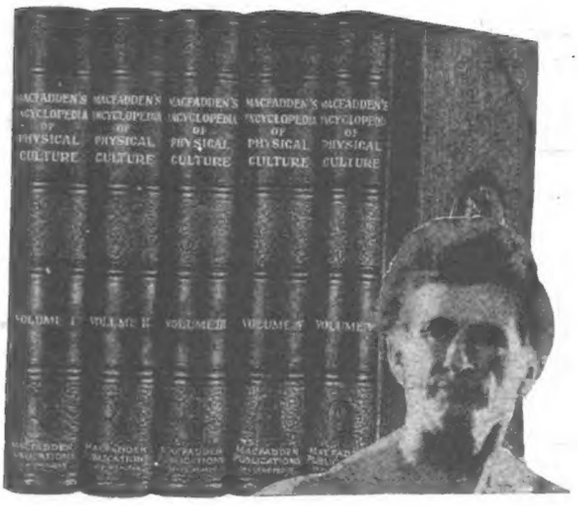

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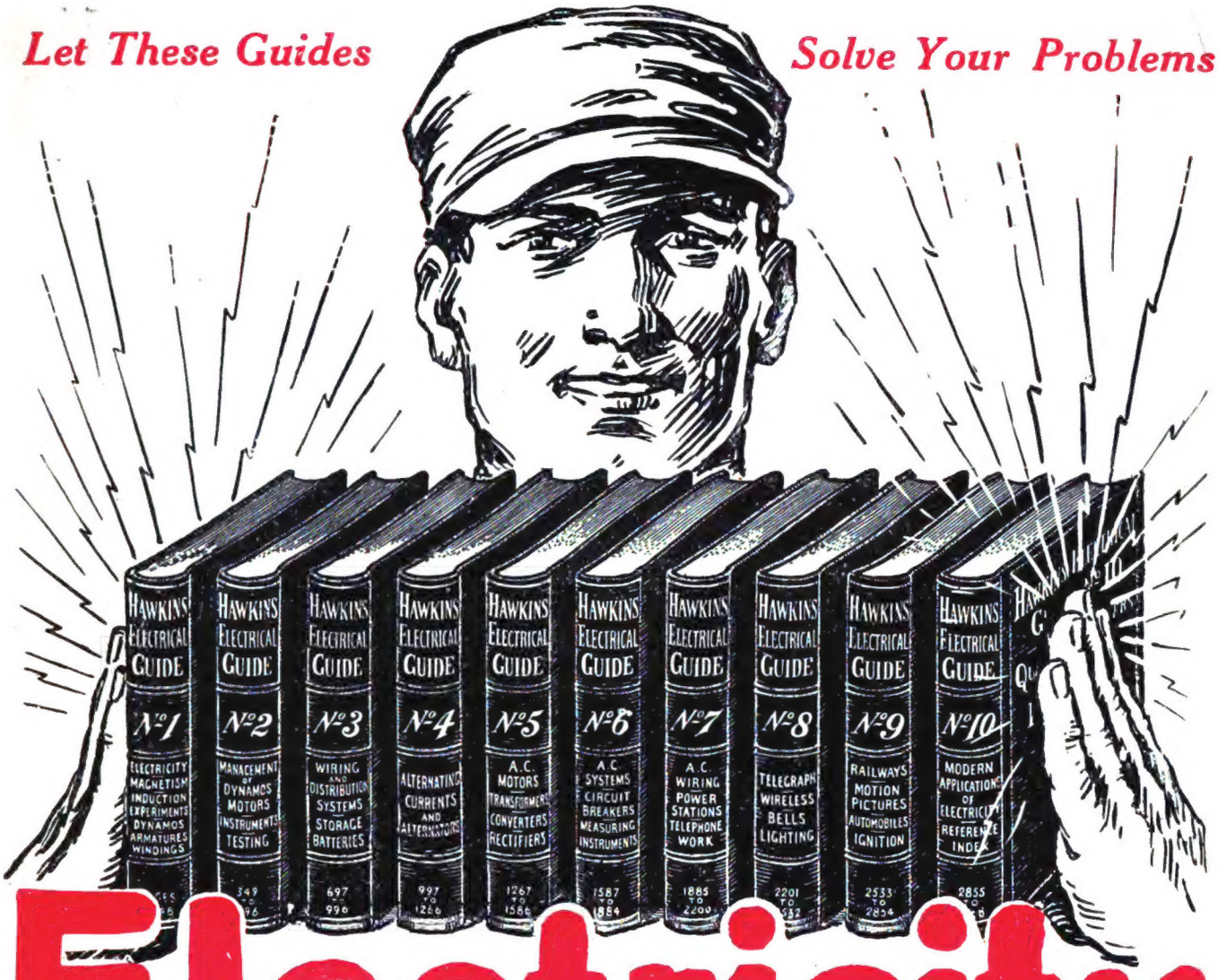

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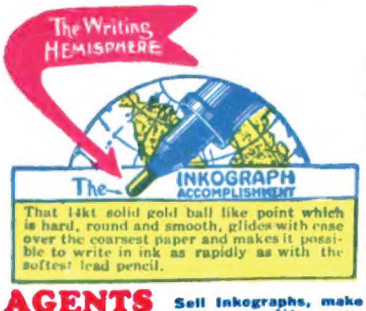
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